A STUDY ON THE BEHAVIOR OF FARMERS REGARDING CHEMICAL UTILIZATION FOR THE PROTECTION, CONTROL AND ELIMINATION OF PLANT PESTS: CASE STUDIES OF CASSAVA, SUGARCANE AND MAIZE IN CHAINAT AND SUPHANBURI PROVINCES

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ABSTRACT

This research on the behavior of farmers planting cassava, sugarcane and maize at Chainat and Suphanburi Provinces aims to study their behavior in chemical application. Data collection was conducted with a total of 278 farmers by questionnaire with structured interviews. 51 of the farmers plant cassava, 150 sugarcane and 77 maize data assessment was computerized with SPSS for Windows. General data is presented with description of features and characteristics, quantity, frequency and data distribution. Statistical applications are Percentage, Mean and SD. The relation of co-efficient between an independent variable (level evaluation) and dependent variables is conducted by one tail variation statistical analysis.

The research reveal that the farmers have a high level (97.48%) and medium level (2.52%) knowledge of chemical application; medium level (98.20%) and high level (1.80%) experience in the dangers of chemical application; moderately corrected (98.92%) and highly corrected (1.80%) behavior in chemical application. Most of the farmers (84.17%) encounter problems with chemical application particularly with expensive chemical fertilizers. In this aspect, the related chemical suppliers and government agencies should disseminate additional practical knowledge on chemical substances to the farmers, for example, Effective Micro-organisms (E.M.).

For the hypothesis testing, the study found that personal factors such as gender, age, educational level, annual income, size of farm land, characteristics of land tenure, information received, agricultural period, period of pesticides usage, and risk experience from pesticide application have no effect on behavior-use of chemical pesticides. The key factors that affect their behavior on the use of chemical pesticides are their experience of the danger of using chemical substances and their knowledge of chemical application.

The result of the study reveals the necessity of providing knowledge of chemical application to improve the understanding of chemical pesticides for farmers generating.

KEY WORDS: BEHAVIOR / CHEMICAL PESTICIDE / CASSAVA / SUGARCANE / MAIZE / CHAINAT / SUPHANBURI

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การศึกษาพฤติกรรมเกี่ยวกับการใช้สารเคมีป้องกันและกำจัดศัตรูพืชของเกษตรกรผู้ปลูกมันสำปะหลัง อ้อย และข้าวโพดในพื้นที่จังหวัดชัยนาท และจังหวัดสุพรรณบุรี (A STUDY ON THE BEHAVIOR OF FARMERS REGARDING CHEMICAL UTILIZATION FOR THE PROTECTION, CONTROL AND ELIMINATION OF PLANT PESTS: CASE OF CASSAVA, SUGARCANE AND MAIZE IN CHAINAT AND SUPHANBURI PROVINCES)

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บทคัดย่อ

การศึกษาพฤติกรรมเกี่ยวกับการใช้สารเคมีป้องกันและกำจัดศัตรูพืชของเกษตรกรผู้ปลูกมันสำปะหลัง อ้อย และข้าวโพด ในพื้นที่จังหวัดชัยนาท และสุพรรณบุรีครั้งนี้ มีวัตถุประสงค์เพื่อศึกษาพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืช และปัจจัยที่มีผลต่อพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืชของเกษตรกรที่ปลูกพืชไร่ในจังหวัดชัยนาทและสุพรรณบุรี โดยเก็บรวบรวมข้อมูลผ่านแบบสอบถามประกอบการสัมภาษณ์เกษตรกรผู้ปลูกมันสำปะหลัง อ้อย และข้าวโพด ในจังหวัดชัยนาทและสุพรรณบุรี จำนวน 51, 150 และ 77 ราย ตามลำดับ จำนวนรวมทั้งสิ้น 278 ราย จากนั้น ผ่านการประมวลผลข้อมูลด้วยโปรแกรมสำเร็จรูป SPSS for Windows โดยข้อมูลลักษณะทั่วไป นำเสนอในรูปแบบของการบรรยายถึงลักษณะ ปริมาณ ความถี่ และการกระจายของข้อมูล สถิติที่ใช้ คือ อัตราส่วนร้อยละ ค่าเฉลี่ย ค่าเบี่ยงเบนมาตรฐาน ส่วนความสัมพันธ์ระหว่างตัวแปรอิสระ 1 ตัว (ระดับการวัดเป็นกลุ่ม) กับตัวแปรตาม 1 ตัว (ระดับการวัดเป็นช่วง) ใช้สถิติการวิเคราะห์การผันแปรทางเดียว

จากการศึกษาพบว่า เกษตรกรมีความรู้เรื่องการใช้สารเคมีในระดับมาก (ร้อยละ 97.48) และระดับปานกลาง (ร้อยละ 2.52) มีความรู้เรื่องอันตรายจากการใช้สารเคมีในระดับปานกลาง (ร้อยละ 98.20) และระดับมาก (ร้อยละ 1.80) และมีพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืชถูกต้องปานกลาง (ร้อยละ 98.92) และถูกต้องมาก (ร้อยละ 1.08) โดยเกษตรกรส่วนใหญ่ (ร้อยละ 84.17) มีปัญหาหรือข้อเสนอแนะเกี่ยวกับการใช้สารเคมี ได้แก่ ปุ๋ยเคมีราคาแพง หน่วยงานที่เกี่ยวข้องควรให้ความรู้เพิ่มเติมเกี่ยวกับสารเคมีแก่เกษตรกรให้มากยิ่งขึ้น รัฐบาลควรส่งเสริมให้มีการใช้ปุ๋ยชีวภาพมากขึ้น เป็นต้น

สำหรับการทดสอบสมมติฐาน พบว่า เพศ อายุ การศึกษา รายได้ต่อปี ขนาดพื้นที่เพาะปลูก และลักษณะการถือครองที่ดิน ซึ่งเป็นปัจจัยส่วนบุคคล การได้รับข่าวสาร ระยะเวลาในการประกอบอาชีพ จำนวนปีที่ใช้สารเคมี และความรู้เรื่องอันตรายจากการใช้สารเคมี ซึ่งเป็นปัจจัยทางสภาพแวดล้อมทั่วไป ไม่มีผลต่อมีพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืช ส่วนปัจจัยที่มีผลต่อพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืช ได้แก่ ประสบการณ์ในการได้รับอันตรายอันเนื่องมาจากสารเคมี และความรู้เรื่องการใช้สารเคมี

ผลการศึกษาได้สะท้อนให้ทราบถึง ความจำเป็นในการให้ความรู้เรื่องการใช้สารเคมี เพื่อพฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืชที่ถูกต้องในกลุ่มเกษตรกรดังกล่าว

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CHAPTER I
INTRODUCTION

1.1 Background and State of Problems

Agriculture has chronologically been the most crucial occupation for Thailand since the country was founded. Because of its topography, Thailand has not only favorable climatic conditions and geologically environment but also has a plenty of water resources to serve agricultural activities. (Cherdsak Amnuaysilp, 1998)

Formerly, agriculture was commonly considered as self-dependence to support at household or community consumption level. It depended on labor or cattle. Thailand has although been developed into new industry country, agriculture remain a major economic factor. Rapidly increasing of population affected to the demand of farmland expansion. Local varieties, which are low productivity and poor farming systems, are replaced by high yield varieties. Farm machines, chemical fertility and pesticides are applied with maximum yield crop for growth acceleration and weed eradication. These practices create many problems such as imbalance nature, deforestation and environmental pollution impacts especially air, water resource and soil as shown in Table 1-3.

Chemical pesticides have been introduced to Thailand around ten years ago and usage tendency been increasing. However, it seems that the more usage of pesticides, the less plant epidemics is alleviated. The out-break of disease and insect inevitably spread including harm to human life and environment. (Anut Tapinta, 1993)

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Nowadays chemical pesticides is necessary to all farmers in order to maximize agricultural yield and improve self-sufficiency. The extensive used of pesticides has been continuously raising especially in the central and eastern part of the country. (See detailed in Table 1-1 and 1-2) The usage rate of both is so high at 62% of total area.

Table 1-1 Sales Volume of Chemical Pesticides in Thailand during 1984-1989

Chemical Pesticides	**Sales Volume/Year (Unit: M/T)**					
	1984	**1985**	**1986**	**1987**	**1988**	**1989**
Insecticide	14,309	14,127	12,428	13,947	19,835	25,317
Fungicide	3,931	3,725	3,725	6,265	7,352	7,628
Herbicide	14,114	14,334	11,496	14,240	27,802	44,275
Acaricide	1,028	651	793	2,017	2,041	2,222
Rodenticide	17	26	34	86	451	760
Fumigant	360	584	813	457	777	507
Growth Regulator	-	-	-	-	-	170
Total	**33,759**	**33,452**	**29,289**	**37,012**	**58,258**	**80,879**

Source : Office of Agricultural Regulation, Department of Agriculture, 1990

Table 1-2 Usage Rate of Chemical Pesticides in different regions of Thailand

Region	**Usage Rate (%)**	**Main Plants**	**Favorable Chemicals**
Central and East	62	Rice, Vegetables and Fruits	Folidol E605, Lannate
North	25.8	Rice, Tobacco, Bean, Lichee and Longan	Furadon, Sumicidin
South	7.8	Rubber	Lannate, Sumicidin
Northeast	4.3	Rice	Gramoxone,2 ,4 , 5-T Folidol E605, Sevin

Source : Staring,1984

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Using pesticides cause 3 major problems to the environment as follows. (Anut Tapinta, 1993)

1) Imbalance of Nature The accumulation of pesticides impact on food chain and sustaining of many natural livelihoods both directly and indirectly. This will eventually lead to imbalance of resident system. For example, Predators and Parasite, the natural antagonism of pest and controller of plant endemics are destroyed. Bees and birds are declined. Epidemics also spread to fish, owning to pesticide consumption. In addition, the deposition of pesticide in stream will probably cause the problems in the future.

2) Chemical Residuals in the Nature Many chemicals are durable affected into the food chain and environment. When farmers undertake those chemicals, those of them will spread and deposit into soil, water resources, air including agricultural products and aquatic fauna. Although the problems cannot be notice clearly, the environmental properties seem to be inevitable deteriorated. Thus, all countries should mutually collaborate to resolve these problems.

From the study of Office of National Environment Board in 1987-1988, there are plenty chemical residuals in soil, water resources, environment and sediment in stream. It also found that those of chemicals' deposited in agricultural products such as orchard, vegetables and field crops, respectively. (Table 1-3). As shown, the chemicals deposition is under the safety standard however the increase of these depositions have been probably over standard if the used of pesticide rising continuously.

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Table 1-3 Percentage of pesticides Deposition in different areas in 1987-1988

Samples	Number of Analysis Samples	Number of Residuals founded	% of Residual
Plantation Soil	76	76	100
Sediment	71	71	100
Water	139	120	86
Vegetables	246	61	25
Field crop	34	11	32
Aquatic Fauna	49	32	65

Source : Office of National Environment Board, 1990

3) Public Health Problem Pesticides is harmful both to farmer body and all people who consume chemicals residues in agricultural product leading to symptom and death. From Office of National Environment Board survey as jointly with 60 Provincial Public Health Offices in 1985 and 67 Provincial Public Health Offices in 1987 found the patients causing from pesticide at 5,458 persons in 1985 follow the increased by 9,738 persons in 1987. The death is also raised. In 1985, there is 384 and 499 death in 1987. (Table 1-4). As considering, the said patients and deaths are tendency less than actual due to the patients never receive any treatment in the hospitals.

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Table 1-4 Statistics of people received Chemical Pesticide by region

Region	Patient			Death	
	Year	Persons	%	Persons	%
Central and East	2528	2,570	47.1	163	42.4
	2530	4,183	42.9	226	45.2
North	2538	1,822	33.3	143	37.2
	2530	3,767	38.6	138	27.6
Northeast	2528	667	12.2	50	13.0
	2530	1232	12.6	68	13.6
South	2528	399	7.3	28	7.3
	2530	556	5.7	67	13.4
Total	**2528**	**5,458**	**100.0**	**384**	**100.0**
	2530	**9,738**	**100.0**	**499**	**100.0**

Source : Office of National Environment Board, 1988

Table 1-5 Statistics of people received Chemical Pesticide by causes and occupation

Cause	Patient			Death		Occupation	Patient	
	Year (B.E.)	Persons	%	Persons	%		Persons	%
1. Suicide	2528	3,221	59.0	334	86.9	1. Agriculture	3,459	63.3
	2530	4,480	46.0	424	84.9		6,513	66.8
2. Ocupation	2528	1,401	25.6	10	2.6	2. Employee	659	12.0
3. Accident	2530	3,519	36.1	19	3.8		1,359	14.3
	2528	299	5.4	4	1.0	3. Student	411	7.5
4. Food residues	2530	601	6.1	19	3.8		639	6.5
5. Homicide	2528	90	1.6	1	0.2	4. Housewife	248	4.5
	2530	198	2.0	11	2.2		348	3.5
	2528	21	0.3	3	0.7	5. Government	53	0.9
	2530	28	0.3	3	0.6	Officer	100	1.0
6. Others	2528	20	0.3	0	0	6. Others	217	3.9
	2530	54	0.5	0	0		277	2.8
	2528	406	7.4	32	8.3	7. Not specified	411	7.5
7. Not specified	2530	858	8.8	23	4.6		665	4.1
Total	**2528**	**5,458**	**100.0**	**384**	**100.0**	**Total**	**5,458**	**100.0**
	2530	**9,738**	**100.0**	**499**	**100.0**		**9,738**	**100.0**

Source : Office of National Environment Board, 1990

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The impact of pesticide accumulation , contamination and imbalance of nature reveal and take effects to human as far as agriculture remain vital to the country. Upon the aforesaid reasons, the researcher study of farmer behavior at Tha Chin River Basin, which is one of twenty-five important Thailand river basins with its quality below standard level. (Wichan Simachaya, 2002: 354,361). This study is covered two agricultural areas using pesticides in Chainat and Suphanburi provinces. Both provinces have grown the important field crops in the central part of Thailand along Tha Chin River basin. Hence this intends to study three field crops as sugar cane, cassava and maize.

The researcher also anticipated that this study is able to reveal the farmer behavior in using of chemical pesticide, urge those farmers' awareness and be the core database for planning of plantation, using pesticides, conserving environment and creating awareness to related units in planning of pesticide application and its impact.

1.2 Research Objectives

1.2.1 To study the farmer behavior in applying chemical pesticides in field crops at Chainat and Suphanburi provinces.

1.2.2 To study those of factors effected to the farmer behavior in applying chemical pesticides in field crops at Chainat and Suphanburi provinces

1.3 Scope of Research

This research aim at studying the farmer behavior of Sugar Cane, Cassava and Maize in applying chemical pesticides at Chainat and Suphanburi provinces (Fig. 1-1 and 1-2).

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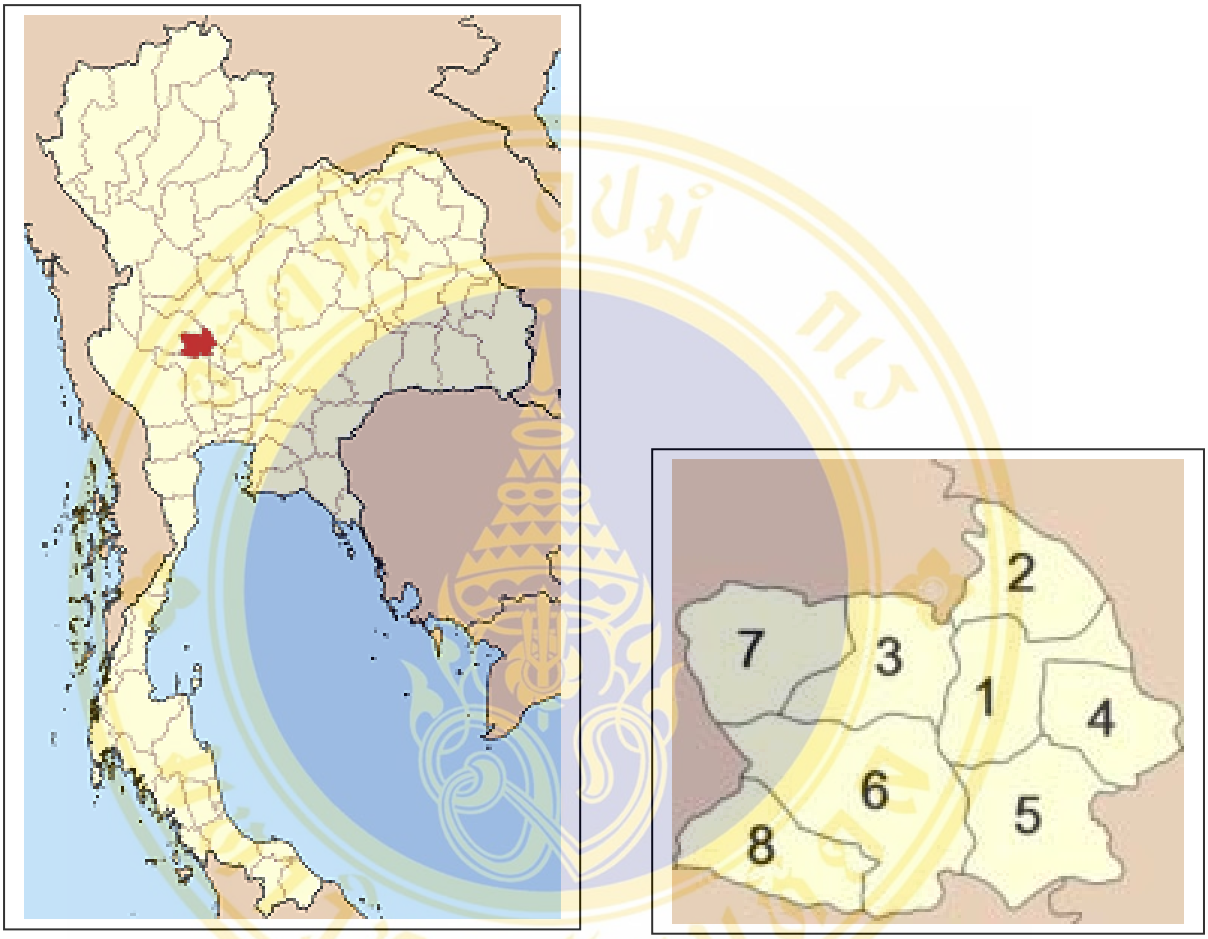
Fig 1-1 Chainat province map



Chainat: Administrative Divisions

Chainat is subdivided into 6 districts (Amphoe) and 2 minor districts (King Amphoe). The districts are further subdivided into 53 sub-districts (tambon) and 474 villages (muban).

1. Amphoe King Amphoe
2. Mueang Chainat
3. Manorom
4. Wat Sing
5. Sapphaya
6. Sankhaburi
7. Hankha
8. Nong Mamong
9. Noen Kham

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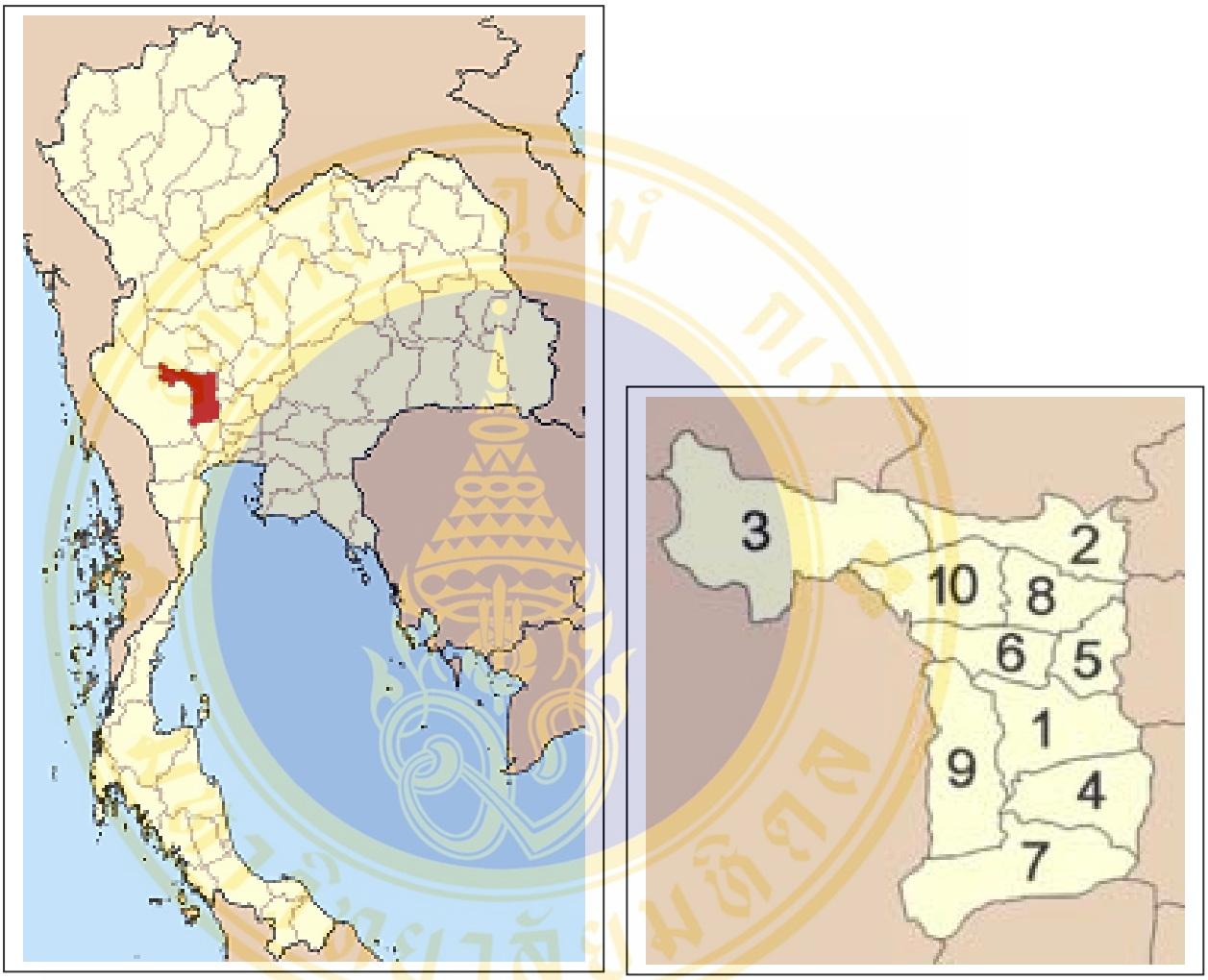
Fig 1-2 Suphanburi province map



Suphanburi: Administrative Divisions

Suphanburi is subdivided into 10 districts (Amphoe). The districts are further subdivided into 110 communes (tambon) and 977 villages (muban).

1. Mueang Suphan Buri
2. Doem Bang Nang Buat
3. Dan Chang
4. Bang Pla Ma
5. Si Prachan
6. Don Chedi
7. Song Phi Nong
8. Sam Chuk
9. U Thong
10. Nong Ya Sai

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1.4 Definition used

Farmer is a person who plant sugar cane, cassava and maize and run activities regarding chemicals pesticide application. He can be a landlord, renter, or a person who earn his living from planting field crops (sugar cane, cassava and maize)

Behavior is an internal and external human act or action response to the stimulus objects or surroundings.

Chemical Pesticide means all chemicals used by farmers before, during and after cultivation in order to protect and eradicate plant attracts and preserve agriculture product quality.

Annual Income is one-year earning profit received from agricultural activities and from three crops as sugar cane, cassava and maize.

Size of Farmland means plantation area per rai where can be owned or rented by farmers.

Characteristics of Land Tenure is to own or rent a farmland for agricultural activities.

Agricultural Period is a number of years to make agriculture (plant field crops as sugar cane, cassava and maize)

Period used of pesticide is a number of years using pesticides for planting field crops.

Information received is the frequency of information received concerning pesticide application from trading agent, marketing officer, medicine label, colleague suggestion, television, magazine, newspaper, advertising, internet and so on.

Risk experience from pesticide application means own experience to use or not use to get pesticide toxic

Knowledge of Pesticide Application is an official standard or instruction to use chemical pesticides properly.

Knowledge of Pesticide Danger is an understanding of chemical pesticide toxic or its danger and impact.

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1.5 Variables used in this Research

1.5.1 Independent Variables are comprised of

- Personal Factors e.g. gender, age, education, annual income, farmland size, characteristics of Land Tenure
- General Environmental Factors e.g. information received, agricultural period, number of years used of pesticide, risk experience from pesticide application, knowledge of pesticide application and knowledge of pesticide danger

1.5.2 Dependent Variables

Dependent Variables are the farmer behaviors concerning pesticide applied in sugar cane, cassava and maize field at Chainat and Suphanburi provinces.

1.6 Variables and Measurement Level

Table 1-6 Variables and Measurement Level

Variables	Measurement Level
Independent Variables	
1. Personal Factors	
- Gender	NOMINAL
- Age	NOMINAL, INTERVAL
- Educational Level	NOMINAL, INTERVAL
- Annual Income	NOMINAL, INTERVAL
- Size of Farmland	NOMINAL, INTERVAL
- Characteristics of Land Tenure	NOMINAL
2. General Environmental Factors	
- Information received	NOMINAL
- Agricultural Period	NOMINAL, INTERVAL
- Period used of pesticide	NOMINAL, INTERVAL
- Risk experience from pesticide application	NOMINAL, INTERVAL
- Knowledge of Pesticide Application	NOMINAL, INTERVAL
- Knowledge of Pesticide Danger	NOMINAL, INTERVAL

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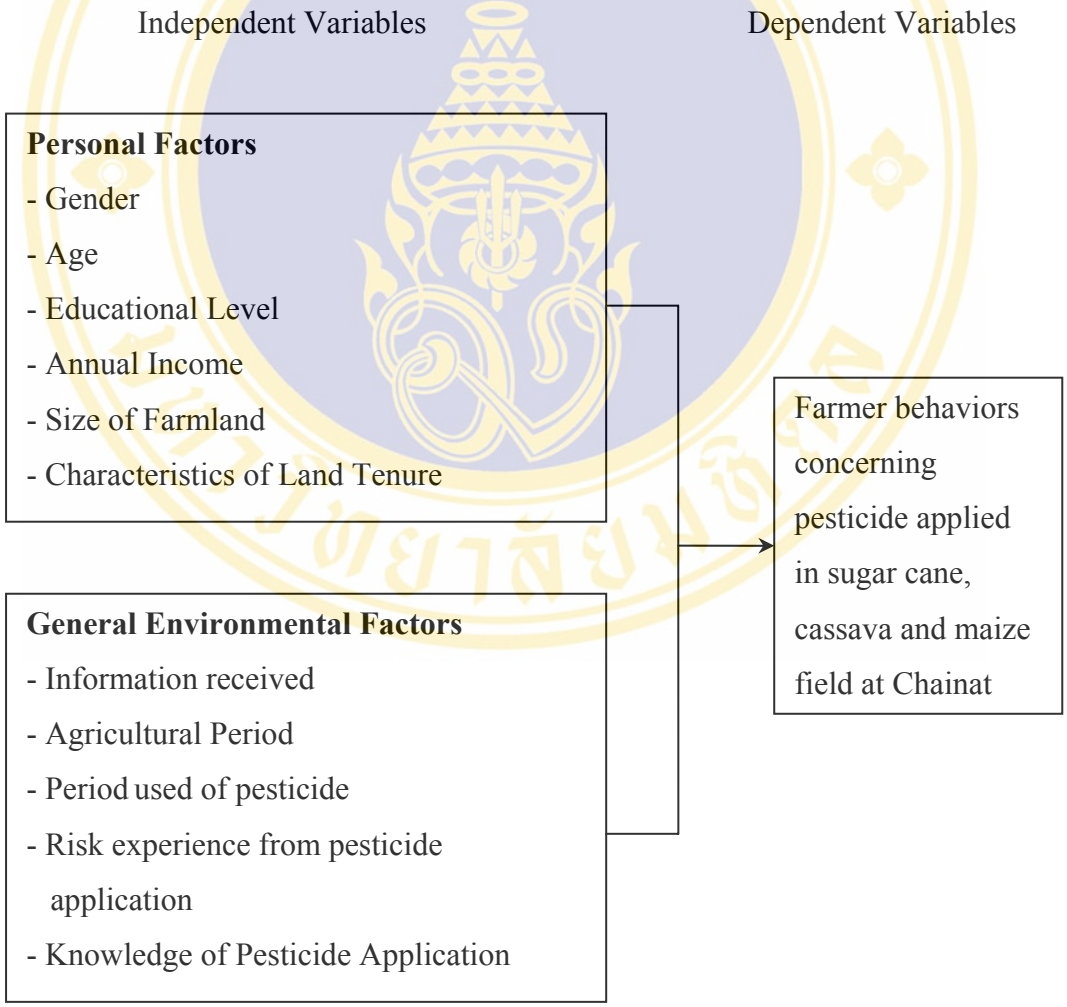
Table 1-6 Variables and Measurement Level (Cont.)

Variables	Measurement Level
Dependent Variables Farmer behaviors concerning pesticide applied in sugar cane, cassava and maize field at Chainat and Suphanburi provinces.	NOMINAL, INTERVAL

1.7 Framework of Research



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1.8 Assumption

1.8.1 Personal Factors e.g. gender, age, education, annual income, farmland size, characteristics of Land Tenure cause a difference farmer behavior applied pesticide in cassava, sugar cane and maize field at Chainat and Suphanburi provinces as presented.

1.8.1.1 Female has a difference behavior from Male in using pesticide.

1.8.1.2 Farmers being difference ages have difference behavior in using pesticide.

1.8.1.3 Farmers being difference educational levels have difference behavior in using pesticide.

1.8.1.4 Farmers being difference annual income have difference behavior in using pesticide.

1.8.1.5 Farmers being difference size of farmland have difference behavior in using pesticide.

1.8.1.6 Farmers being difference characteristics of Land Tenure have difference behavior in using pesticide.

1.8.2 General Environmental Factors e.g. information received, agricultural period, number of years used of pesticide, risk experience from pesticide application, knowledge of pesticide application and knowledge of pesticide danger cause a difference farmer behavior applied pesticide in cassava, sugar cane and maize field at Chainat and Suphanburi provinces as presented.

1.8.2.1 Farmers being received difference information have difference behavior in using pesticide.

1.8.2.2 Farmers being difference agricultural period have difference behavior in using pesticide.

1.8.2.3 Farmers being difference number of years used of pesticide have difference behavior in using pesticide.

1.8.2.4 Farmers being got difference risk experience from pesticide application have difference behavior in using pesticide.

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1.8.2.5 Farmers being gained difference knowledge of pesticide application have difference behavior in using pesticide.

1.8.2.6 Farmers being gained difference knowledge of pesticide danger difference behavior in using pesticide.

1.9 Expected Outcome

1.9.1 Understand farmer behaviors applied pesticide at field crop (sugar cane, cassava and maize) in Chainat and Suphanburi provinces

1.9.2 Understand effected factors both proper and improper farmer behaviors applied pesticide at field crop (sugar cane, cassava and maize) in Chainat and Suphanburi provinces

1.9.3 Be baseline data for planning, problem solving and developing of pesticide application at field crop (sugar cane, cassava and maize) in Chainat and Suphanburi provinces as well as able to a guideline of interested persons.

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CHAPTER II
REVIEW LITERATURE

This Research, which conduct, summarize and having a guidance basis from many concepts, theories, documents and related researched have been designed into 7 components as follows:

2.1 Behavior Theory
2.2 Knowledge of plant and plant pest
2.3 Knowledge of chemical pesticide
2.4 Knowledge of chemical pesticide danger
2.5 Impacts on environment and human health
2.6 Knowledge of field crops (sugar cane, cassava and maize)
2.7 Research related to personal factors, economics, socialization and population assigned to the behavior of pesticide application

2.1 Behavior Theory

2.1.1 Definition

The meaning of human behavior is differently defined as follows:

The Royal Institute Dictionary defined that human behavior is the act or action of muscles thought feelings response to the stimulus object. Cherdsak Chalueaysilp (1998 :14) referred to (The Royal Institute Dictionary, 1987 : 580)

Chudda Chitpithak (1979:2) described that behaviorism imply as a social science concerning the interaction of people in society. The related characteristics and process of behaviorism affected to various human actions were considered and displayed both internally and externally as presented in Figure 2-1.

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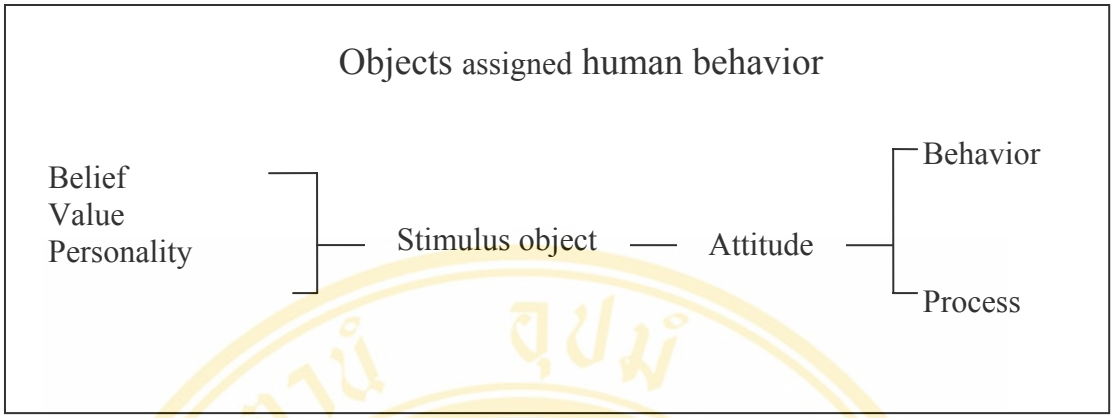

Source: Chuda Chitpithak (1982: 73)

Figure 2-1 Component and Relationship of Behavior

Sopha Chupikulchai (1978:2) defined that behavior acts as the actions of living objects which can be seen or experimented e.g. laughing, crying, eating, playing and sleeping etc.

Prapapen Suwan (1983 : 15) said that behavior means all human activities which can or cannot be seen e.g. speaking, thinking feeling, interesting etc.

Viranat Mahakij (1993:23) told that behavior defines as any activity performed by human and can be expounded by analysis. .

Considering of all abovementioned definitions, behavior is concluded as both over and cover action response to the stimulus or activated objects

2.1.2 Types of Behavior

Reference is made from Cherdsak Chalueaysilp (1998 :15) to Sucha Chanaim, human behavior can be classified into 2 categories as listed.

1) Over Behavior or External Behavior is defined as an apparent action performed by acting.

2) Cover Behavior or Internal Behavior is defined as in side recognition of person being anticipated by external action such as affection, cognition, emotion, perception, decision making, attitude and need. This action is unseen but able to observe by measurement tools.

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2.1.3 Components of Behavior

Cronbach (1972: 14) explained that human behavior can be categorized in 7 elements as follows.

1) Goals are needs or objectives made people to act in order to response to their needs. Some actions can immediately serve human needs while others can't. People also have various needs but will prioritize its response.

2) Readiness is implied as mutuality level or ability necessary to that activity in order to response

3) Situation is events which create opportunities for people to select the action to response.

4) Interpretation Before running any activity, people will firstly consider the situation and follow by making decision to choose the most favorite outcome.

5) Response is an action response to needs by interpreting

6) Consequence is the result of activity which probably confirmed or contradicted.

7) Reaction to Thwarting People may react to awkward situation if it cannot serve the people needs

Thongchai Santiwong (1972 : 21) defined that human behavior should be a key action in determining the social and psychological factors. Psychological factor such as cognitive system is the center of store and memory stories while social and environment factor is store information and past experience together with value and attitude. These crucial stories are depended on individual understanding of perception and comparison process for analysis and decision making in order to behave.

Thepnom Mueangman and Swing Suwan (1986:7) remarked that behavior is came from attitude components as details.

- Cognitive component
- Affective component
- Behavioral component see Figure (2-2)

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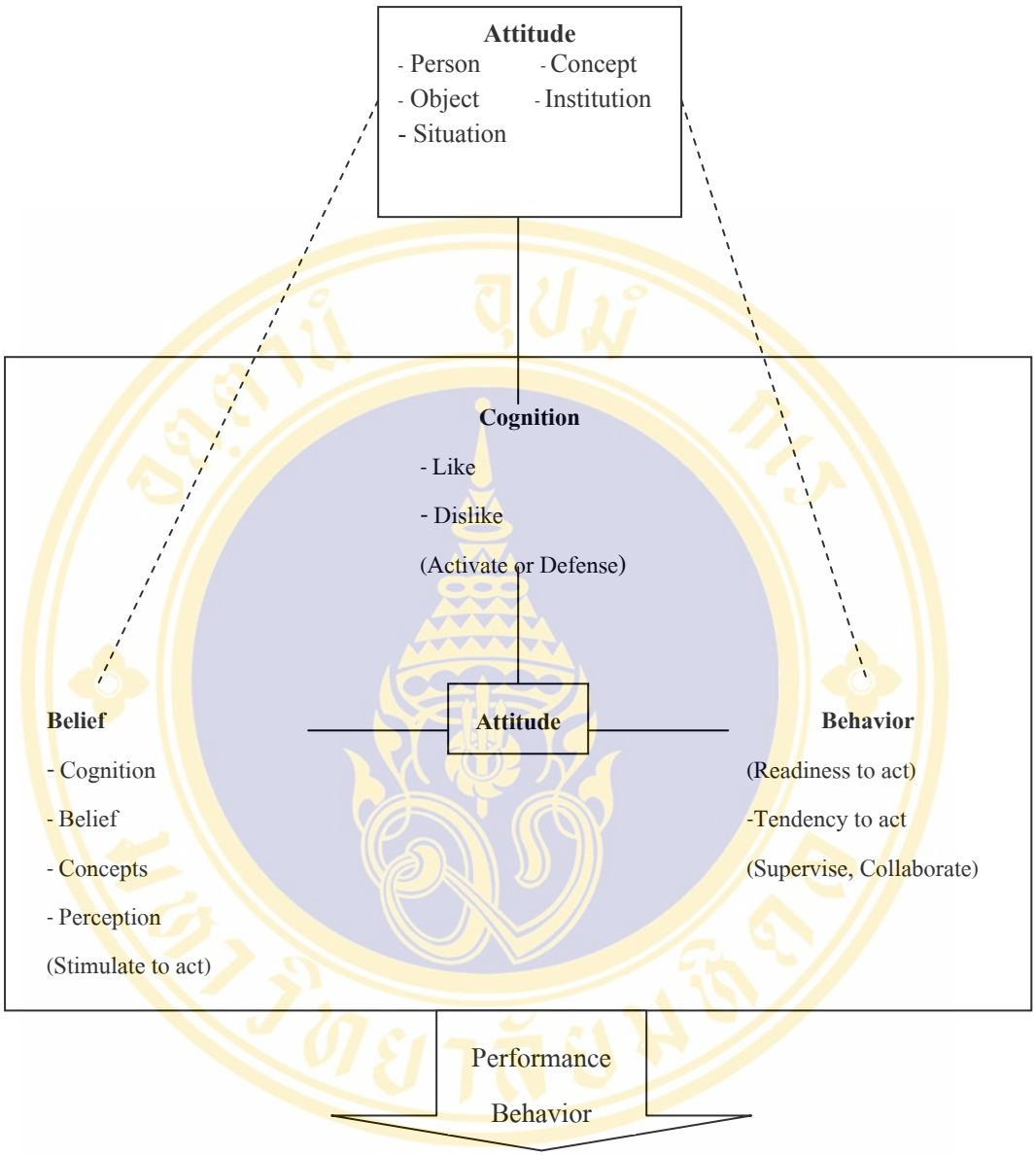

Source: Thepnom Mueangman and Swing Suwan (1986: 8)

Figure 2-2 Component of Behavior by Thepnom Mueangman and Swing Suwan

2.1.4 Incident of Behavior

Cherdsak Chalueaysilp (1998 :15) reference to Orathai Chuenmanut (1992 : 10) explained that behavior is the relation of 2 objects as listed

1) Stimulus is an object activated to human body to response as incident or precedent action such as his mouth watered when he saw mango with sweet and sour fish paste. Hence, human body was volubly activated and mount

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watered by mango with sweet and sour fish paste. Saliva fluid is the behavior occurred after saw that mango while that mango is called stimulus.

2) Response is an incident reaction activated by stimulus object. For example, as aforesaid sample, mouth watering arises after saw the stimulus object which is mango with sweet and sour fish paste. So, saliva fluid is the response of this case.

Viranart Manakij (1993:14-16) has classified the Variable in Human Behavior into 2 variables as follows.

1) The Person Variable is genetic which stipulated the human physical and biological behavior to distinct from that of animal. Those of human behaviors are so multifaceted. They are not only composed of limbs nerves, glands, bones, muscles and brains but also vital to human living and adjustment.

2) The Environmental Variable is the influence of naturally environment inaction and Social culture reaction throughout human lives including all situations happened promptly, in the past and in the future.

Nuaysiri Paorohit (1990:98) said that human behavior is assigned by society enclosed. The manipulate of environment cause different variation under different personality.

Cherdsak Chalueaysilp (1998:17) refereed to Ubonrat Pengsatit (1990:231) remarked that behavior incident can be identified into 3 types.

1) Behavior which arises from the interaction of the stimulus and response objects e.g. Students are lined in from of Thai red flag when a bell is ringing.

2) Behavior which arises from the interaction of the stimulus and response objects e.g. Smoking is occurred when having the stimulus as cigarette and ignited fire.

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Cherdsak Chalueaysilp (1998:17) referred to Nipa Kaewsringam (1992:83) categorized behavior factors into 2 factors namely Genetic factor and Environmental factor. These factors have influenced all individual maturities and impacted more on human behavior presented.

Cherdsak Chalueaysilp (1998:17) referred to Sathein Homkhajohn and team (1992:16) pointed that human behavior is created from 2 components as listed.

1) External Component namely all objects being seen and contacted.
2) External Component is the inner sensation of in dividable which affected to human behavior variation.

From the afore said concept of the behavior incident these can be a guild line and crucial factor for this research which assigned into 2 factors as follows.

1) Person Factor namely gender, age, educational level, anvil income, size of farmland and characteristics of land possession.
2) Stimulus Factor and General Environmental Factor namely information received, agricultural period, number of years used of pesticide, risk experience from pesticide application, knowledge of pesticide application and know ledge of pesticide danger.

2.1.5 Theory of Human Behavior

This is to study the farmer behavior who plant cassava, sugar cane and maize in Chainat and Suphanburi provinces. This research intends to study the stimulus factors consequent to the behavior of conscious person. Whereupon, the concepts and theories of motivation are conducted as a guideline of this research as presented:

2.1.5.1 Theory of A.H. Maslow

Wasana Sukhakul (2006:11) referred to John B. Miner (1992:55-57) talked about the basic human needs of the well-known Maslow General Theory of Human. Human needs are developed in chronological order. When the first response was hit, the Stage I will intermittently motivate but stimulate by replacing with the response factor in the next order. At the same time, the

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replacement is not achievable if the Stage 1 factor isn't response. Motivation will be in a chronological order of Hierarchy of needs as shown in Figure 2.

The 3 fundamental criteria of Theory of Human Motivation are illustrated as follows.

1. Human is a person living with needs. Human will be motivated by needs in order to gain a choice of reaction required. Needs which entirely received reaction will not motivate behavior. But, needs which not gain reaction will influence on the behavior.
2. Human needs are ranged in a sequential prioritized order from common objects to extra and extreme objects, respectively.
3. The Low-order needs will primarily be responded and followed by the next order ones.

Under Maslow Theory, it is unnecessary to pursue the order of Hierarchy of Human Needs as lined from Stage 5. In case of sickness a person can step from Stage 5 to Stage 2. This theory can be changed in accordance to situations or events or needs or can be in reverse order.

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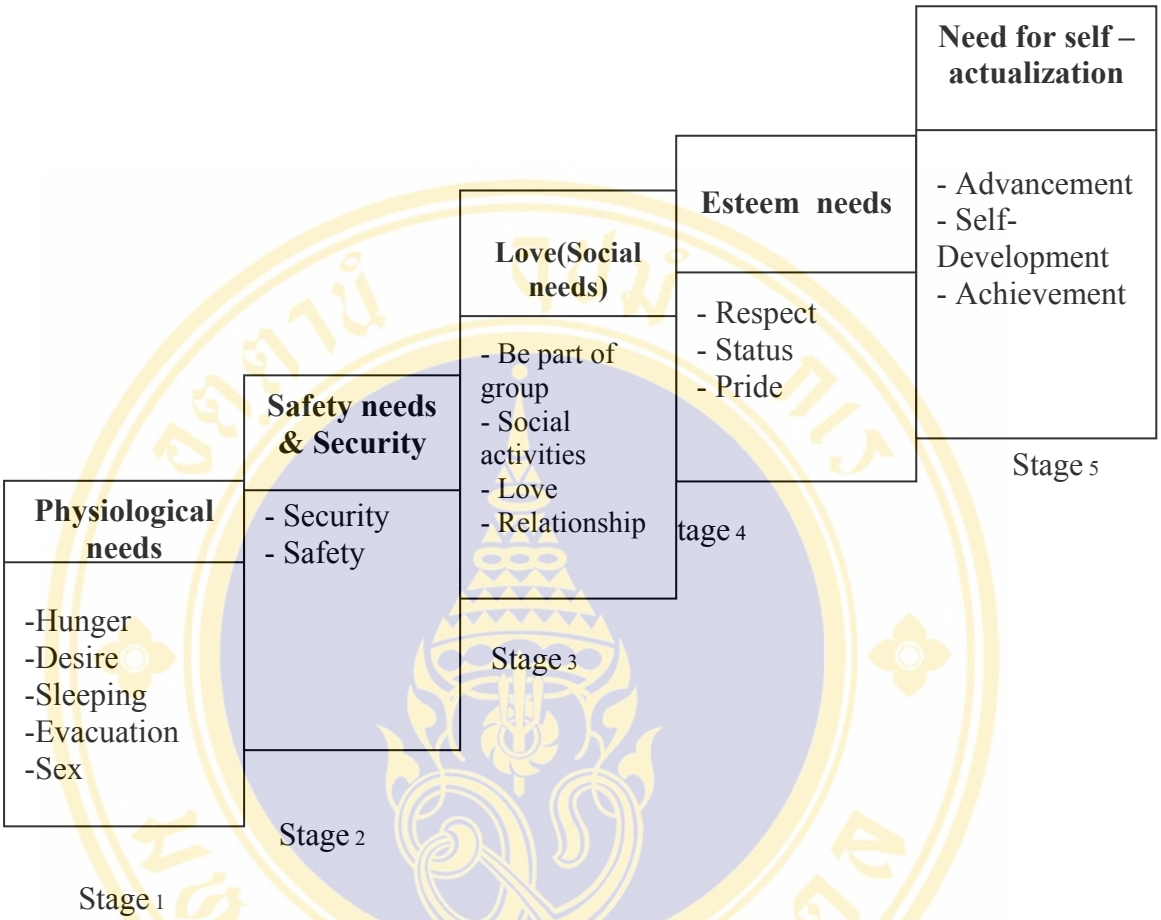
Maslow General Theory of Human Motivation



Source : Thonglor Dechthai Pincipal of Public Health Management, 1997: 196

Figure 2-2 Sequence of person needs

2.1.5.2 Theory of Clay ton P. Alderfer

This theory was developed from Maslaw theory and summarized human needs as experienced into 3 needs as follows.

1. Existence Needs (E) is comprise of assorted necessary things for human life including needs for materials, hunger, desire residence and survival.

2. Related Needs (R) is the need for association with others. For example To be a member of family, supervisor, colleague, trend together with acceptance, assurance and understanding are the fundamental of relationship process.

3. Growth Needs (G) is the need for self-actualization, advancement, self development, achievement and esteem

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Theory of E.R.G. is based on the fundamental problems namely

1. Thwarting Needs The needs would be added if the response to existence needs and related needs were lessen. In conclusion, thwarting needs lead to the increasing of needs.

2. Thwarting Needs lead to declination. For example, the less the related needs are responded, the more the existence needs. While the response to growth need is down, the related need is up. Thus, when the response to thwarting is less than actual target, a person will retreat to more security needs.

3. Growth needs. The more the existence needs are responded, the more the related needs. The more the negated needs are also responded, the more the growth needs. That is, if there is more reaction to human needs, they will seek for less security but pursue more self-actualization and growth.

2.1.5.3 Theory of Mccleland

Theory of Mccleland implied that each person can likely motivate his action in difference ways. This action concerns to existing motivation, a chance and situation. Or it implied that motivation and two perceptions to the situation namely expectation to achieve target and valve of motives related to exiting target art the stimulus objects of human behavior.

2.1.5.4 Equity Theory

Equity theory of J. Stancy Adam remarked that workers will assess wages of each other compared to the same job quantity and quality. In case, ones gain lower wages, they are unsatisfied and try to reduce that inequity.

The comparative of equity can be conducted individually or in a group from the same or different workers by comparing the present performance with the past performance in order to assess the received wages.

2.1.5.5 Murray Theory of Needs

This theory identified that need are initiated by human and made effect to his behavior as concluded.

- Need to win by performing aggressive action
- Need to win to overcome all obstacles
- Need to lose

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- Need self-protection
- Need Freedom
- Need success
- Need to make relationship with others
- Need joyfulness
- Need to assist others
- Need to separate from others
- Need to be impressed
- Need to influence others
- Need to respect the seniority
- Need to avoidance from critic and punishment
- Need discipline
- Need to maintain reputation
- Need to differentiate from other

Murray noticed that needs may sometimes be initiated in accordance to internal human motive and under social conditions. In other word, needs are created due to physical and psychological conditions

2.1.6 Measurement of Behavior

Nuaysiri Paorohit (1990:17-20) proposed the study behavior methods as follows.

1. Field Study is a study from real situation by observing naturally athletic behavior without controlling independent variables. The inspected person is unconscious. Thus, this study is only to observe the behavior or notice the variable relation. The advantage of this study is to know naturally authentic data having many uncontrolled variables. The researcher can recap various outcomes and introduce many suggestions to the next audience. In contrast the cases of behavior are unknown resulting the cases of satiation cannot conclude.

2. Field Experiment is a study from real situation as the Field Study excepted thatVariables of this study are under control. For instance, model situation is formed as a driver made a car broken at the cross junction in order to view an assistance. The variables such as gender and driver age are under control. Conversely,

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this study may not be able control other required independent variables such as accident, police participation and etc.

3. Laboratory Experiment is a study to control various independent variables in laboratory and assess the results controlled by those variables. Upon this study, the researcher can easily initiate the circumstances but lose of naturally authentic environment.

4. Sampling Survey is a study of human cognitive and attitude information whack affect to any past present and future object. The researcher will use this information for conclusion. Whereas, represent as entire population due to inability to apply all population. However, the sampling Survey should be awarded of. If the represented population is authentic, the information may not be reliable and may waste time.

Cherdsak Chaluayslip (1998:22) referred to Somchit Suphan that (1983:131-136) concluded that the method of behavior study can be classified into 2 methods as follows:

1. Direct Behavior Study is exercised by

1.1 Direct Observation such as a teacher observed the students' behavior in the Class by told them for his observation. The students' behavior may probable counterfeit because they are aware of that observation.

1.2 Naturalistic Observation is done whenever an informant is unconscious. This is executed naturally to gain the understanding of real behavior. Never the less, this observation has some limitations according to it took long time notice the required behavior.

2. Indirect Behavior Study is Segregated into different me thuds as listed.

2.1 Interview is the way to put questions to a person or a group by face to face interaction or having a middleman to question. For example in case of interpreter, there are 2 types of interview such as direct interview is to put one by one question following the target objectives. In the other words, indirect interview is the way to put the questions to informants and those informants don't know the interviewer needs.

2.2 Questionnaire is a properly method to study the behavior of a large number of population. Those informants are able to literate or be in remote. In

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addition, both of their past and future behavior can be asked and some information are undisclosed. Questionnaires are also able to execute whenever.

2.3 Experiment is the behavior study. An informant is under control as required. However, this study has some limitations which cannot be applied to the real situation. In contrast, this study is beneficial to the physical study of human behavior.

2.4 Record is a way to study the human behavior by learning from a personal note. That record can be daily note or the study of each behavior such as eating, working or environmental behavior and etc.

2.2 Knowledge of Plants and Pests

2.2.1 Normal Plant Plants, having various physiologies usually work best in accordance with its species. Those of duties are separation of cell, changing of cell form by divided into various derivative cell and initial cell, growth of cell, absorption and movement of plant foods and water light synthesis, movement of synthesized produces to various required parts of plants and to a pulp of fruit for metabolism in order to synthesize substances for plants, plant reproduction and accumulation of food to preserve species across season.

2.2.2 Pests are assorted biotic organism which destroy and make lose to growing trees. These include insects, mites, rodents, birds, weed, microorganism germs that cause plant diseases and abiotic organism which impede plant growth or make lose to growing trees. (Cherdsak Chalveysilp, 1998:25) referred to Udom Detmanee and team 1990:1)

Pest can be classified into 5 classes as follows.

2.2.2.1 Insect

Insects are able to live well in different environment such as in stream and on the ground. Those insects have damaged trees by cutting-biting and sucking-piercing a tree stem and branch, biting a tree root, fruit and seed, siphoning nutrient of leaves, fruit and flower and acted as carriers of plant diseases.

General characterless tics of adult insect are mainly explored as details.

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- Body has 3 parts namely head, thorax and abdomen
- 6 legs
- 2 pairs of mustache

Types of insect can be classified in order or in a group according to its major characteristic as follows.

- Some insects have either no wing, 2 wings (1 pair) or 4 wings (2 pairs)
- Mouth of insects have different types as listed
- Cutting type e.g. grasshopper, cockroach
- Piercing-sucking type e.g. mosque to, plant bug(or reduviid)
- Rasping-sucking type e.g. fire aphid
- Chewing-tapping type e.g. bee, carpenter bee
- Siphoning type e.g. butterfly
- Sponging type e.g. fly

Growth characteristics of insects are listed as follows.

1) Insects have continually metamorphosis in size and figure throughout their life.

2) Some insects have metamorphosis in size only. When eggs are hatched, nymph will continually reproduce to become adults with no wings e.g. silver fish(Cerci. Median caudal filament)

3) Considering some insects, after hatching eggs, nymph shape is similarly to adult but has no wing. Nymph will gradually grow with bigger shape and wings by reproduction to become adults e.g. aphids and plant bug(or reduviid) etc.

4) Some insects have 4 growth stages as listed.

- Egg
- Larval stage has developed from egg. This stage causes lot damage to trees.
- Adult stage has developed from chrysalis. Adults usually have wings.

As abovementioned characteristics, plant pest can be ranged into order or group as identified.

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4.1 Fire aphid Order has the following major characteristics.

- Have wings or no wings. In case of having wings, there are 2 pairs of wings in narrow and long shape and with long hair along wing part.
- Have rasping-sucking mouth type
- Nymph body is similarly to adult
- Always destroy parts of plants such as flower, fruit and leaves in order to make plants disorder or grow slowly.

4.2 Termite Order has the following major characteristics.

- Have wings or no wings In case of having wings, there are 2 pairs of same size wings namely front wings and back wings. If wings are inactive, those of them will overlie on their bodies but in longer shape than bodies.
- Have cutting mouth type
- Nymph is similarly to adult
- Always damage woods in the house

4.3 Grasshopper, Cricket and Cockroach Order

- Have wings or no wings In case of having wings, front pairs are long and narrow but thicker than the back ones, The back pairs like thin membrane and wider than the front ones.

4.4 Plant bug(or reduviid) Order has the following major characteristics.

- Wings have 2 pairs. The front wings are thick and hard while the back wings are thin and clear as membrane.
- Have piercing-sucking mouth type
- Nymph has no wing and its body like adult
- Destroy plants by siphoning the plant nutrient and some siphoned animal blood

4.5 Cicada, Leafhopper, Aphid, Scale Insect and White Fly Order has the following major characteristics.

- Have wings or no wings
- Have piercing-sucking mouth type and destroy plants by siphoning the plant nutrient
- Nymphs of leafhopper and cicada are similar to adult

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- Some types are the disease carriers.

4.6 Agasicles sp. Order has the following major characteristics.

- Have 2 pairs of wings. The front wings are thick and hard while the back ones are thin as membrane. When the back wings are inactive, they will be folded under the front wings. While flying, the front wings are evenly spread while the back ones are flapped.
- Have cutting mouth type
- They grow from eggs to nymph, chrysalis and adult.

4.7 Butterfly and Moth Order has the following major characteristics.

- Adult has 2 pairs of wing with small scales which easily fall from wings.
- Butterfly has bright color while moth has dark-brown color
- Mouth of nymph is in a cutting type and will become a siphoning type in adult stage
- Nymph has 6 legs and be a critical pest of economic plants.

4.8 Fly and Mosquito Order has the following major characteristics.

- Adult has a pair of wings. The back wings have small spots
- Mouth is siphoning type.
- Nymph of fly will be a worm.
- These insects destroy plants and siphon both human and animal blood.
- Be able to be disease carriers.

4.9 Bee, Wash, Hornet and Ant Order has the following major characteristics.

- Some insects such as Bees are usually beneficial to pollination while some are pests.
- Have 2 pairs of thin wing or no wing
- Have cutting mouth type

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2.2.2.2 Mites

Mites are small beetles similarly to insects. Adult of mites has 8 legs (4 pairs) diverse from insects which have 6 legs (3 pairs). They also have no wing.

General Characteristics of Mites

- Adult and middle-aged mites have 4 pairs of legs while nymph has 3 pairs of legs.
- Be a small animal. Body parts are unclearly segregated but connected as a whole.
- No wing
- Growth begins from eggs to nymph with 3 pairs of legs. Nymph will reproduce to be middle aged with 4 pairs of legs mites, follow by adult the 4 pairs of legs.
- Mites siphon the plant nutrient causing its leaf and eyes be pale, red and brown.

2.2.2.3 Rodents

Rodents are small and clever mammals. They like to go about finding food at night and can rapidly reproduce their heredity. Rodents population can be approximately increased 1,000-2,000 rats yearly. They can destroy almost all of plants whenever by cutting. Rodents generally live in wild and uninhabited parts, in thick-wild farm and garden to hidden from their foes. They commonly have 6 types as follows.

1. Bandicota indica
2. Bandicota savilei
3. Rattus rattus
4. Rattus losea
5. Fawn-coloured mouse
6. Ryukyu mouse

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2.2.2.4 Pathogen

Pathogen plants are plants which indicated symptoms diverse from normal plants. Disorders are easily and clearly noticed such as wilt symptom, rotten root, stunted and slow-growth plants etc.

From dictionary, pathogen has 2 meaning as explained.

1. Plant pathogen is the symptom of malady and disorder of plants

2. Any change diverse from normal plant such as changing of growth, changing of plant structure which indicated symptoms of quality and /or economic value.

Upon the aforesaid definitions, each pathologist has introduced the following concepts. (Pairoj Chuangphanich: 1982, 2-3)

Julius Kuhn (1858) Plant Pathogen is the changing of physiological process disordered from normal plant and effect on usual activities of plant parts.

H. War shall Ward (1896) Plant Pathogen is the malfunction state of any portion of plant or physiological disorder.

J.R. Horsfall and A.E. Diamond (1959) Plant Pathogen is the changing of function process due to contagious irritants. Plant pathogen is not an occurrence state, inflections, and malady.

G.C Kent (1973) Plant Pathogen is the lose of energy consumed in stem due to transmittable disease.

In conclusion, plant pathogen is the changing process of energy consumed for plant living. It causes malady and lower economic value according to communicable irritants. This may occur to either biotic or abiotic organism.

Plant pathogens can be divided into 2 categories as follows.

1. Abiotic pathogens are disease occurred in improper environment namely.

- Pathogens from shortage of plant mineral.
- Pathogens from inappropriate environment such as light, temperature, air humidity, air, rain, show, dust and soon.

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- Pathogens from poison substance such as improper used of chemicals.

2. Biotic pathogens are mould, bacteria, virus, earthworms and microplasma. Those microorganism are very small and cannot see by eye. However, we can detect from plant symptoms.

Bacteria create the following symptoms.

1. Rot symptom. The main symptoms demonstrated are rotten with wet slime, and strong bad smell.

2. Blight symptoms spread widen.

3. Wilt symptom Leaves and young branches are simultaneously wilted and bend along the stem then died.

4. Bight spot symptom is the symptom of died cell in a restrict point. It is originated from mould poison.

5. Leaf Stripe Symptom make leaf be pale. When air is humid, fluffy fiber and fungus spores are found.

6. Cassava Ash symptom has white or grey powder covered clumps of tree.

7. Anthracnose symptoms is rather big round or oval brown blight. The pellicle in the center of blight slightly will fall down and also have black spot overlie in pellicle

8. Common rust is a small swelled red-brown or rusty spot which is full of mould spores.

9. Black Spot symptoms Pathogen branches are more swelled than usual and full of mould spores.

10. Basal stem rot symptom usually occurs in a plant sprout. The wet-watering soreness originate at the plant basal stem and later spread to be brown and worn down. The basal stem will bend accordingly.

11. Root Swell symptom Root is more swelled than usual.

12. Top dried symptom occurs at the top of a tree.

13. Scrap symptom The narrow scraps were founded on the fruit peel.

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14. Canker symptoms is hard brown cankerous scraps which a sunk crack in the center.

Viruses create the following symptoms.

1. Color changed symptom is displayed as light and dark green, green and light yellow spread around, leaf stripe is spacious and clear, shortage of chlorophyll cause green faded leaf and mosaic covers with dots.

2. Unusual Growth, Stunted or Halted symptom

3. Blight spot symptom is a died cell formed in a restrict point

4. Water shortage symptom. Some viruses cause the failure in the plant vessel system resulting to wither.

5. Leaf disorder symptom Leaf is more narrow than usual and be distorted or protrude.

Microplasmas cause the following disorder to plants.

1) Yellow spot symptom such as white spot disease of sugar-cane, stem disrepair of citrus trees, yellow spot of Aster.

2) Broom symptom Terminal bud and note put out many clumps of young branches and be stunted.

3) Leaf fibrous symptom Terminal bud and note put out many clumps of leaf hair.

4) Unusual growth symptom Plants will stunt or growth halt.

Earthworms cause the following symptoms.

1) Root swell symptom creates a lump of root swelled.

2) Blight Root symptom create brown stripe blight at root

3) Blight Leaf symptom is a big brown blight.

4) Seed swell symptom seeds swelled more when destroyed by earthworm.

5) Root harden symptom earthworm will siphon the origin of root hair leading to that root put off a little and short or halt the root growth. But a taproot is sustained.

6) Root distorted symptom

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2.2.2.5 Weed

Weeds are unnecessary plant or displace plant which can be classified into 2 types accordance with its shape and characteristics.

1. Narrow Leaf weed is divided into 2 types.

1.1 Gramineate family weed has the following characteristics.

1.1.1 Leaf is narrow and long with parallel mid rib

1.1.2 Stem is round.

1.1.3 Leaf is lined in 2 rows. The example varieties for Gramineate family weed are genus Imperata, Pennisetum polystachyon(L.) Schult., Paragrass(Pannicum Grass)

1.2 Narrow Leaf weed like Gramineate family weed has different characteristics from glasses as follows.

1.2.1 Stem is in a triangle shape

1.2.2 Leaf is lined in rows near the lower stem. The example varieties for genus Cyperuts family weed are Cyperus rotundus, reeds etc.

2. Widen Leaf weed has the main following charactertics.

2.1 Leaf has a variety of shape. Leaf lines knit as a net.

2.2 Leaf is bigger than that of genus Cyperuts family.

2.3 Stem is both round and angle.

The example varieties of wide leaf weeds are thorn spinach (genara Amaranthus and spiny pigweed(Boerhavia), a plant of the family Capparidaceac, a vine of the genus Ipomoea etc.

2.3 Pesticides Knowledge

Pesticides means a substance or a chemical compound which is used to kill, destroy, prevent, control or deform the pest include the substance using for attracting, repelling and growth controlling of pest. (Cherdsak Chaleawsilp, 1998:25 referred to Udom Techmanee and his party 19881:1) or in An Act of Toxic from Government Gazette, vol.84, section 23, dd. March 7th, 1967, page 118, Act 3. In this Act 'Toxic' means the metabolic substances or materials with metabolic substances including normal and hazardous material (Dhammasak Sommart, 1983:317) or chemical

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substance, toxic getting from nature or synthetizing by human in order to destroy, control and prevent pest which annoy human or pets life i.e. Germ, parasite, fly, mosquito, rat and pest that can carry disease to human and destroy the human food source. (Jurairat Kerddonfaek, 1974:84)

2.3.1 History of Pesticides

Plants had been found on this earth for 400 million years ago then 50 million years later, found insects which scientist categorized in Artopod group i.e. the animal that has many-jointed stem while human being, plants, insects, and other animals has its own life style and depend on each other both directly and indirectly e.g. energizing, rotating food substantial or biochemical process etc. This balances the nature dwelling but as the time goes by, the more population the more competition especially human being who are new-born. They make the most waste of nature and are the most important thing to destroy dwelling system which effect to themselves both directly and indirectly. (Kantaros Duangkaew, 1999:10) ref. in Dept. of Agricultural Extension (1996).

In 12,000 years B.C., founded that the insects began to annoy human life. The insects were claimed as the 'pest' when men started first planting for food in 8,000 years B.C. In this age, men tried to invent the pesticide by bringing some plants to exterminate the insects in 2,500 years B.C. together with using another methods i.e. burning stump, not useful plants in the field but now this method is not acceptable as it destroy all useful living things in that area.

For pesticides that come from plants, it continuously developed. In Indian history 800 years B.C., they used the nim leaf mix with the seed plants before storage to prevent the insects. In this age, they found the grain disease i.e. brown leaf and dotted leaf so they used sulfurous fumes to the grain seed before planting. This counted to be the first age of using chemical substance to eradicate the fungus or mold.

For pesticides by bio method, Chinese were credited to be the first who used the ants as a predator to annoy, to repel the pest insects in the orange farm 1,700 years ago.

In 2275 B.E., men started planting by rows in order to easily take care of the plants and pesticide. After the Agriculture Revolution, they first printed the pesticides handbook in 2423 B.E.

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At the beginning of 19th century, there was an serious insect spread 'Philloxera' in middle Europe. They tried to bring the strong branch from U.S.A. but it damaged doubly because of Leaf Stripe Sympton. Mr.Milladet created the drug to destroy the fungi in 2425 B.E. called 'Bouli Bordeaulaet' then changed to ' Bordeaux Mixture' 4 years later according to the town named 'Bordeaux'. This town is famous in grape wining and at the end of the century, L'eau de senate was first used to exterminate the pest in 2433 B.E.

In the early 20th century or 100 years ago, there were many physical method to pesticide e.g.

1. dragging the thin wood with glue around the field or yard, aphides would stick on the glue
2. fly or butterfly trap by laying the bets in the center
3. wrapping the sticky or oily band of leather around the stem to prevent the crawl pest from the ground
4. groove digging to trap worm or maggot
5. water leveling to flood the egg or new born insect at the end of plant
6. to poison or to trap by light
7. use heat or freeze

In 2452 B.E. there were a breeding of cotton and watermelon to use as a anti-disease crop

In 2455 B.E. first started using the quarantine law in U.S.A.

In 2458 B.E. Mr. Sanderson recommended many methods of pesticide e.g. plant rotating, suitable period of planting to prevent the pest spread, take good care of plant by well prepared soil and use fertilizer.

In 2464 B.E. first used air plane to shower the chemical compound in Ohio, U.S.A. to kill Catapa Sphix Moth. Now, this method is protested by the professional and conservative people that it might destroy the environment and dwelling.

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2.3.2 Changing Age

This change started when men was able to synthesize the organic chemistry 60 years ago. This chemistry had highly effectiveness in prevention so it was popular among the farmers and agriculturers. The first chemical substance was Dithoocarbamate using for pesticide by Mr.Tisdale and Mr. Williams. They registered this chemical in 2477 B.E. or as the 3rd age of pesticide invention.

In 2482 B.E. men found DDT which was in the group of Chorinetate Hidrocarbon, Scientists continuously searched for the new. Then found Phosphorus substance in Germany and Carbamate substance in Switzerland. This development was used to kill the insects that carried the disease to human during World War only. After that, the substances were used as a pesticide instead as it was easily used and cheap. Men tried to search for the new substances which cover all but the damages followed.

The first warning was from Switzerland in 2489 B.E. that the house fly was able to resist the DDT. There were more reports that 137 kinds of insects also did resist until U.S.A. announced that DDT was forbidden in 2515 B.E. and 33 chemicals in 2532 B.E.

Thailand in the past, chemicals had been used open wide and seemed to increased as the spread of insects and pest because they were able to resist the chemicals and also lack of man power to take care of their plants.

This chemical is hazardous directly to human, animals, living organisms and effect to the environments also the export market. This problem, we and all concerned people understand and try to avoid using the chemicals by extracting the substances from plants. Many plants have their own qualifications that can be used to control the pest. We get them from their leaves, stems, roots, seeds and flowers etc.

Thailand forbid to use some chemicals since 2520 B.E. until now. Agriculture Dept. does not register or not allow importing some chemicals according to Act of Toxic 2510 B.E. and Act of Hazardous material 2535 B.E. The government promoted the agriculturist to use the mixing method to prevent the pest in country policy in the period of National Economic and Society Development Plan, version 7 (2535 – 2539 B.E.). Until now, it is clearly specified the plans of agriculture

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promotion year 2540 in the part of nature conservative and environment under the National Economic and Society Development Plan, version 8 (2540 - 2544 B.E.)

2.3.3 Types of pesticides

Mr. Meechai Wasayant (2535:144 -147) categorized the pesticide chemicals as follows:-

1. Group of Chlorinated hydrocarbons is a synthesis which has Chlorine as a major compound. The important substances are DDT, Linden, Heptachlor, Mirex, Dinedrin, Endrin, Toxaphene etc.

2. Group of Organophosphates is a synthesis which has Phosphorus as a major compound. The important substances are Parathion, Methyl Parathion, Tetra ethyl Pyrophosphates, Folidol etc.

3. Group of Carbamate is a synthesis which has Nitrogen as a major compound. The important substances are Carbaril, Sevin, Bygone, Furadan etc.

4. Group of plants synthesis which is poisonous to insects but very little or none to animals. These substances can be vanished in bio environment, no pending toxic. They are :-

4.1 Pyretthril is synthetized from Pyrethrum flower.

4.2 Nicotine is from tobacco leaves.

4.3 Rianine is synthetized from Red Lotin and White Lorin or we normally call as a Lotin.

4.4 Besides, there are more from Nim, Citronella Grass etc.

4.5 Currently, Office of Agricultural Regulatory; Dept. of Agricultural Extension categorizes the agricultural toxic into 6 groups according to how to use it :-

1. Acaricide
2. Fungicide
3. Fumigant
4. Herbicide
5. Insecticide
6. Rodenticide

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Department of Agricultural Extension; Ministry of Agriculture and Cooperatives (1988:3-4) categorized the pesticides according to the its method to destroy the pests into 4 groups :-

1. Oral Chemical. This chemical will pass through the bets from mouth through digestive system i.e. Deldrin, Sulphur, Arsenic etc.

2. Touching Chemical. This chemical will pass through the bets by touching and will effect to a nerve, breath system of the bets. Some chemical can burn the plants leaves e.g. DDT or BSC to the red bean. The samples of these chemical are Ababesin, Nicotin Pyratetum, Entrin, Parathyon, Temiton, Savin, Carathane etc.

3. Sucking chemical. This chemical has been sprayed or sprinkled and sucked to the parts of the plants. When pests bite or eat the plants, they die. This is efficient to the insect that use mouth to suck. The sample are Chemiton. Phorrate (Thymate), Mevinphos, Dimenthoate etc.

4. Fumigated Chemical. This chemical easily evaporate and pass through the bets in form of gas through the breathing system. This method usually uses in the storage warehouse and can be used to all kinds of insects e.g. Nicotin, Hydrogen gas, DDVP, Siyanite, Carbondisuphite, Carbontetrachloride, Methypromite Nemagon etc.

The Notification of Ministry of Agriculture and Cooperatives, no.1, 2532 B.E. concludes that there are 5 types of toxic chemical in agriculture.

1. Material or metabolic substance or chemical compound of metabolic substances that are used for killing, destroying, controlling the insects and pests which are the enemy of livestock

2. Nicotin which is extracted from tobacco leaves, are used for preventing the aphids. Nicotin can be harmful to human too if men take only 4 mg., they may slubber, vomit, squeamish, running stomach, slow pulse etc.

3. Rhyania is a small bush in South America. It is used in form of powder but not widespread and it is poisonous.

4. Lotin or Rotinone which is extracted from Red Lotin and White Lotin and can be found in Thailand by grinding their roots and mix with water. This is poisonous to insects but for human, men may slubber, vomit or irritate to the skin and eyes.

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There are more interesting plants that can be extracted to insecticide e.g. Hardly dead worm plant, Oleande leaf, pepper seed, sunflower, citronella grass, custard apple seed, hemp, nim, etc.

2.3.4 Concepts of Pesticides Application

Pesticides are not only useful but also dangerous and have bad effect to environment and human life. Therefore, the users especially the farmers should learn and understand clearly about their usage otherwise they can destroy the plants.

Cherdsak Chaleawsilp (1998:37-38) ref. in GIFAB (1993:6) summarized the effect factors of using pesticides are as follows :-

1. The efficiency of spraying machine should be safe, clean and are in good condition.
2. The users should know of what kind and how much of insects or pests that are destroying their plants.
3. The pesticides and insecticides should match with the types of pests and insects and in the suitable amount.
4. Chemical storage should be kept properly in order to remain its quality and prevent the danger that may cause from it.
5. Mixing of chemicals should strictly do as its instruction in order to provide best result and users' security including the environment.
6. Chemical fumigation should calculate the usage correctly and immediate fume after mixing to keep the best result and avoid the danger that may cause to children or pets.

The period of using the insecticides and pesticides are as below :-

1. Pre plant = using chemicals before planting
2. Pre mergence = using chemicals after planting but before the plants grow up.
3. Post mergence = using chemicals after the plants grow up.
4. After productivity collecting = using chemicals to prevent and kill the pests in order to keep the best quality of the productivity before sell.

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Entomology and Zoology of Dept. of Agriculture (1986:4) advise how to use insecticides as below details: -

1. Should buy the insecticides with correct labeling according to the government Act of Toxic as follows :-
   1.1 Have a picture of ‘ Skull ‘ with the word ‘ Toxic Material’ in black or red alphabet.
   1.2 Have chemical name, generic name of substances and trade name.
   1.3 Manufacturer name and address
   1.4 Quantity of the chemical substances
   1.5 Expiry date (if available)
   1.6 Explanation of allergy, basic first aid and instruction for the doctor. This can be printed on the leaflet.

2. Insecticides Using
   2.1 Use when necessary, suitable with type of insects, not overdose or over the instruction.
   2.2 Read the instruction carefully before use.
   2.3 Wear proper clothes, hat, eye glasses, gloves and mask before mixing and fumigating to avoid the chemical.
   2.4 Use the good condition of spraying machine to avoid the chemical leak to the body.
   2.5 Notice the wind direction. Don’t spray against the wind or let the chemical spray to men, pets, food, house or drinking water of the people nearby.
   2.6 Don’t smoke cigarettes or eat food during spraying.
   2.7 If the chemical touch any part of the body, immediately wash with soap.
   2.8 Take a bath to avoid the chemical that might leak on the clothes, put on new clothes after each spraying.
   2.9 Clean the spraying machine after finish. Be careful not to allow the rest of the chemical flow into the water.
   2.10 Don’t enter into the spraying area unless necessary.

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2.11 Use the chemical that easily สลาย with the nearly pick up plants. However, timing is up to the chemical instruction.

2.12 If get the toxic chemical, act according to label instruction then send to the hospital with the chemical container to let the doctor examine it.

3. Transportation and storage

3.1 Separate the insecticide from other materials esp. people, animals and food

3.2 The insecticides should be packed in strong package.

3.3 Storage the insecticides far away from people, pets and living area and not mix with the food.

3.4 In case of fire, evacuate people from that zone and report the fire brigade of the types of pesticides.

4. Get rid of the insecticides

4.1 When the chemicals flow on the floor, cover up with soil or sawdust then bury away from the community.

4.2 When there is a large amount of chemicals leak, cover up with lime or sawdust that has alkaline characteristic before bury.

4.3 Destroy all the chemical containers and bury properly. Don't wash or clean the container and re-use them.

4.4 Don't burn plastic or insecticide container that has pressure, it can burst out.

4.5 The insecticides that remain from use, don't use but should bury in a deep hole which buffer with mortar and should be away from the water source.

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There are some advices about how to destroy the chemical container and the remaining chemicals :-

1. Destroy all the chemical containers to avoid the danger that might be reached to people, pets and environment.

2. Burn the paper box, bag and plastic is a suitable way. If there is a specific stove to avoid smoke, gas or soot spread in the air, the temp should not less than 1,100 degree celsius to burn all chemicals completely. If there is no high temp stove, should burn together with dry wood and prevent the smoke from people or pets. The ashes should be buried the same as their containers

3. Steel, tank, glass or plastic container should be buried. Before burying, should wash with water and this washing water can be used in the next mixing. To clean the container before burying is necessary. The bury area should be away from the water source. The container should be broke or beat to avoid the re-use. The depth of the hole should be at least 50 cm. and marked for notification.

The farmers or the chemicals users should strictly act as the instruction although the chemicals are hazardous, they might not harm or also reduce the effects to the users or concerned people, environment.

2.4 Knowledge of danger from pesticides

Pesticides has danger in many level, low up to high level according to the types, and the amount.

Entomology and Zoology has level the toxic of chemicals by Oral LD_{50} mg/kg into 6 levels :-

1. Most harmful toxic = Oral LD_{50} mg/kg < 5
2. Harmful toxic = Oral LD_{50} mg/kg < 5 – 50
3. Medium harmful toxic = Oral LD_{50} mg/kg < 50 – 500
4. Little harmful toxic = Oral LD_{50} mg/kg < 500 – 5,000
5. Very little harmful toxic = Oral LD_{50} mg/kg < 5,000 – 15,000
6. Non harmful toxic = Oral LD_{50} mg/kg > 15,000

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Currently by law, we use Acute Oral LD_{50} and can be grouped as

1. Harmful toxic = Acute Oral LD50 less than 50 mg/kg
2. Normal toxic = Acute Oral LD_{50} more than 50 mg/kg

However, even some toxic are categorized into normal toxic but later found that during produce process or during use is hazardous, it can be claimed as harmful toxic,

In 2533 B.E. Toxic Material Registry Sub-Committee accepted the pesticide leveling of WHO by using the color bar on the label.

1. Red stripe means harmful toxic, Oral $LD_{50,}$ solid type less than liquid type = less than 200 and Skin LD_{50}, solid type less than 100, liquid type less than 400
2. Yellow stripe means harmful toxic, Oral LD50 ; solid type 50 – 500, liquid type 200 – 2,000 and Skin LD50, solid type less than 100, liquid type less than 400 – 4,000
3. Blue stripe means harmful toxic, Oral LD50 ; solid type more than 500, liquid type more than 2,000 and Skin LD50, solid type more than 1,000, liquid type more than 4,000
4. Green stripe means toxic level is low.

Human can get the toxic from pesticides into 3 ways ;-

1. Oral
   - dust, dirt while spraying
   - drink by accident
   - suck or blow the chemical pipe or injector
   - eat food with chemical mixed up
   - hand or part of body wipe the mouth accidentally
   - drink from bottle with chemical mixed up
2. Skin
   - chemical spilled on part of the body or on clothes
   - spray chemical in the windy area
   - chemical split in the eye or body while mixing
   - touch the sprayed area

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- children play in the chemical thrown area or container, fix the machine without cleaning

3. Breathing
   - breath dust, dirt dust, dirt while spraying
   - smoke while spraying
   - chemicals split on cigarette
   - breath while mixing

Danger from pesticides happen into 2 cases :-

1. Sudden case, by get a big amount of chemical, will stupefy, dizzy, vomit, spasm and may die.
2. Chronic case, by get only little chemical but for a long time, will be weak e.g. brain, kidney, blood circulation. This causes the weakness, not appetite, and dies later.

Signs after receiving toxic chemical can be concluded into 3 groups according to type and the usage i.e.

1. sign of receiving little harmful toxic; getting headache, powerless, tired, sweat, stupefy and throat irritating.
2. sign of receiving medium harmful toxic; getting squeamish, vomit, blur eyes, body shake, cramps, frequent breath, nerve, sweat.
3. sign of receiving harmful toxic; spasm, heart attack, faint, slow pulse and die.

Department of Agriculture Extension (1995: 25 – 28) summarized the toxic of different pesticides are as follows:-

1. Toxic from Organophosphate compound. Generally, our bodies get this from skin and this chemical easily crumble. It effects to nerve system and internal organs. The signs are the smell like that toxic when breathe out. This can happen within 2-3 minutes or in half an hour according to the amount taken. Start with getting headache, powerless, sweat, hardly breath, sweat, stupefy, tear including excrete continuously and fainted.

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2. Toxic from mercury organochlorine. This substance easily crumble in fat and accumulate in body which direct effect to nerve cells. General signs are powerless, tired, sweat, stupefy, feel num in lips, tongue, face, headache, body stiff, muscle spasm start from neck, unconscious, but pulse and breath are in normal condition. In serious case, slow pulse and not smooth. If get a lot, may die because the chemical suppress the brain that control the breath.

3. Toxic from Carbamate. The signs are similar to organochlorine receiving.

4. Toxic from arsenic. This effect to gastric system and all system will operate slowly. The obvious signs are serious stomach ache, vomit, running stomach, low blood pressure etc. After getting this toxic only 20 minutes, those signs will clearly show and die in 48 hours as loss water.

5. Toxic from Dinotrophinol or Herbicides. The signs are high temp fever, sweat, frequent breath, faint. Some are easily alarm, dried throat, thirsty, lose weight. In chronic case, die in 24 - 48 hours.

6. Toxic from mercury. Usually fingertip, tongue, lips are spasmodic, headache. Some are disable to think, write, speak or walk normally.

7. Toxic from pesticides e.g. Tiquot and paraquot (grammoxzone). The signs will appear slowly but cannot be cured. If eat, will die. If breath, will be toxic or break out skin, if percolate into skin.

8. Toxic from arsenic. Only eat the large amount of it, can die. The general signs are bloody, small blood vessel break and may have blood from nose, stomach ache and backache.

9. Toxic from plant extract i.e. Stricknin will be skin itchy, red rash on the skin, sneeze, running nose, slaver

10. Toxic from plant extract i.e. Pyrethrum will be skin itchy, red rash on the skin, sneeze, running nose, slaver

11. Toxic from plant extract i.e Nicotin will have skin burn. If suck into the body, will easily excite, discourage. If take a large amount, may die in 1 hour but generally within 5 minutes because the heart muscle stop work.

12. Toxic from plant extract i.e. Lotin. Generally irritate to eyes and skin

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13. Toxic from fumigate substance esp. Methybromite. If touch it, the skin will burn like acid. If breath, kidney will be destroyed then die. If take a small breath, will be forgetful, lose memory, sight problem, body shake, hardly move, speak. The Chlorobikrin fumigation will make eyes irritation. The Carbontetrachloride fumigation will effect the nerves system, kidney and lung cells.

Dept. of Agriculture Extension summarized the remedy from these toxins by 3 majors which can be used in all cases :-

1. Get rid of the touch chemical
    1.1 Bring the patients from the chemical area.
    1.2 Wash out with water but don't use alcohol or warm water.
    1.3 Swallow the chemical, try to vomit (in case the patient is fainted, immediately sent to the doctor) or drink water mix with salt (1 cup of water / 1 spoon of salt)
2. Elimination of chemicals from body.
    2.1 drink water a lot
    2.2 take medicines or other treatment as advised by physician.
3. Removing chemical poison
    3.1 Acid poison can be removed by vinegar, fresh milk or egg
    3.2 Alkaline poison can be removed by fresh milk
    3.3 Organofosfhates acids-Carbamate can be removed by coal.
    3.4 Paraquat can be sponged by fluid.
4. Using Anti-metaboli substance
    4.1 Carbamate to eat or inject Artropine
    4.2 Organofosfhates to eat or inject Artopine 2 Pam

In addition, the body system of such a person undertaken chemical poisons may disorder. His breathing system is fast or irregular. The important aids are to hold him in open area and expand his chest. Some lost consciousness, have a lot sweat, and cold. The aids are to clean his body in order to reduce sweat and let his body dry and cover him with blanket. In case of paused breathing, his nails and face turn to green quickly. Aids are to activate his heart by pressing or beating his left chest timely.

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2.5 Impacts on environment and human health

Applying of pesticides impacts on the environment pollution due to its spread and residue in plants and animals.

2.5.1 Environmental pollution.

Pesticides residue is not only in the used area but also spread and deposit in a range area. The poison begins residue in soil and plant stem. After spraying, some was deposited while other spread into the air or sponge into the ground follow by run off an water-table if raining. The biotic organism then uptake this residue explained as follows.

1. Dissemination of pesticides in soil For planting, farmers always use pesticides for pre-plant, pre mergence and post mergence, soil so directly absorb those chemicals. Some pesticides also apply in the house and create more residues into the ground. The soil residues can be circulated as listed.

1.1 Chemical decomposition

1.2 Photo degradation

1.3 Microbial degradation

1.4 Volatilization

1.5 Movement by run of a water-table

1.6 Plant or organism uptake

Under soil, some pesticides can easily degrade but other are so durable and deposit last long such as Organochlorin. The durable pesticides which are difficult to degrade and dangerous to environment are shown as follows.

Poison Chemicals	Decomposition Percentage 95 (year)
Aldrin	1-6
Chlordance	3-5
DDT	4-30
Dieldrin	5-25
Heptachlor	3-5
Lindane	3-10

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2. Dissemination of pesticides in water resource. The contaminations of pesticides run off water-table are from the following reasons.

2.1 Directly spraying the pesticides to water resource. This is to eliminate mosquitoes and watering weeds.

2.2 Rain has eroded away all top soil and run off to water resources

2.3 The waste water ventilation from houses and factories were made without elimination of pesticides

2.4 Throwing and cleaning pesticide containers in the stream.

2.5 Applying pesticides in the field near by the water resource.

The pesticide run off a water table make the following effects.

Ability in dissolving varieties of pesticides is different. Organochlorin is hardly dissolved and so durable in water: These chemicals are hold with soil particles and suspend in water. Most of them will become residue and rarely evaporate to the atmosphere. Different soil particles sponge different pesticides.

3. Deposition of pesticide in food Plants can receive pesticides in various ways.

The quantity of residue remain upon the following factors

3.1 Types of pesticide are based on types of pathogen, knowledge of pesticide application of farmers and safety period of cultivation

3.2 Movement of chemical poison runs off a plant from root or young leaf. Spraying method and chemical formulas affect on the quantity of residue.

3.3 Different types of soil will differently deposit poison chemicals.

3.4 Rain can circulate pesticide from air to plant and erode such a pesticide from leaf and stem.

3.5 Varieties of plants can differently assimilate poison chemicals and in different ways. Through root, outer leaf peel or crack along cell skin

Farmers always Overuse of pesticide and be a ware of the cultivated safety period. These are risky and create residue in plants. Most of them are Organochlorin and Organofosfhates namely DDT, Aldrin, Diedrin, Lindrin Heptachlor, Malathion and Phosdrin.

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4. Deposition of pesticide in animals which are from

4.1 Direct spraying Animals can uptake pesticides in 3 ways as from food, breathing and skin. The chemicals will deposit in their membrane and organs.

4.2 Indirect way Animals can indirectly uptake pesticides from the food chain such as from food producer, plant and water resources.

5. Deposition of pesticide in human People can uptake pesticides in 2 ways as directly and indirectly and indirectly ways as animals. People e.g. farmers, persons used pesticides at home, factory worker can indirect uptake such chemicals by eating food, drinking water etc.

2.5.2 Impacts from agricultural pesticide Pesticides significantly make unfavorable environment to all biotic organisms. User are usually not aware of the pesticide disadvantage, Overuse, over expect of it results and waste a lot money to correct the danger of pesticides (Nuaysri Thayapatch, 1990)

Pesticides may take the following impacts to the environment pollution and all biotic organisms.

1. Impact on resident system Agricultural pesticide application has effected to the quality problem of important environment in resident system such as soil, air and water resources. The application is usually done by injecting or spraying. In case of directly injection, many residues may probably remain in the soil and continually increase according to types of soil. Soil in such an area can poison to plants if plants assimilate high quantity of pesticides. These pesticides also affected to pollution and resident system of water resources.

2. Impact on biotic organism Apart from damage of plant and animal pests, pesticides are inevitably harmful to all biotic organism as human, animals and plants due to its residue. All biotic organisms can directly uptake the chemical poisons. Such as pesticide dust sprayed from farmland or nearby area applied pesticides. In addition, biotic organism can indirectly uptake the chemicals from the food Chains, once the plant root and leaf assimilate the pesticides, the pesticides are circulated to accumulate in animal and human bodies. When they take a plant, assimilation of poison in food chains will continually increase starting from a small organism to a big organism, respectively. Accumulated biological magnification lead the living

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organism in food chains to uptake more accumulated poison and initiate disorder of organic system or changing of biotic organism behavior such as breeding, migration and growth. These pesticides sometime can accumulate more in biotic organism membrane with harmless. These can later accumulate until to the intense level which be harmful to human.

3. Impact on plant pest Insects and plant pest resist anted to varieties of poisons were enormously increased. Those of important insects are diamond back moth and brown plant hopper. Both insects cannot be eliminated by some pesticides because of its resistant. Therefore, pesticides are applied more and may change to others.

4. Impact on natural opponents of plant enemy. Varieties of insect quantity are usually controlled by natural opponents. When chemical poison spread natural opponents have been destroyed and lose of control in nature. This is effect to the in crease of plant enemies.

5. Impact on aquatic livings and any animal. The spread of pesticide poisons to environment are clearly harmful to aquatic faunas especially fish. Residue will be deposited and damaged many fishes such as Endrin, Diedrin, Endosulfan, Carbofuran, Azinphos-ethyl and Pyrethroids. Apart from aquatic faunas birds and other animals are damaged and decrease their quantity due to those poisons.

6. Impact on economics Poison residues in agricultural produces, which are consumed in domestics and export are not only effected to human lives and health but also economics of a country. The buyers will reject those of produces if the poisons are founded.

2.6 Knowledge of field crops (Sugar cane, cassava and maize)

This study is aimed to choose those of 3 field crops namely sugar cane, cassava and maize according to they are the most important economical plants next form rice.

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2.6.1 Sugar cane

2.6.1.1 History of world Sugar cane planting

Sugar cane was founded since 300 years before Christ. In Hindu history was verified that sugar cane has been grown and produced in verities of sugar. Most are produced in the form of molasses, soft drinks and syrup. Next, sugar cane was planted in the south of China and Persia in the early sixth century, and from Persia to Saudi Arabia and in the north of Europe such as Spain and Italy (Cicely Island) Sugar cane is now the important crop in Egypt and south Spain only Morocco and Italy have quitted its planting due to unfavorable climate. In the sixteenth century the plantation has expanded to Hispaniola Island (now is the Dominican Republic) and West Indies Island namely Cuba and Portorigo and to the central and north of America. In the eighteenth century, it was grown in Morisia Island, Australia and Hawaii Island.

2.6.1.2 Origin of sugar cane species grew in Thailand.

There are 2-3 native species namely *Nam Phueng* Sugarcane, *Kha Kai* Sugarcane, and *Khaem* Sugarcane . The sugar plant was established by Chinese at Nakornchaisri River Basin for 100 years ago. That produced only brown sugar from one of three species but it has been closed.

In B.E 2470, Marshall Chao Pray Surasakmontri has initially established the sugar factor but not succeed. In B.E. 2480 was firstly established in Thailand and finished in B.E. 2481 by using อ้อยขาไก่ as a raw material. However, these canes provide low-percentage of sugar, insuffient plantation area, and low yield per rai leading insufficient sugar cane for sugar production. The next sugar factory was founded in Uttradit and used Kha Kai Sugarcane as a raw material as in Lampang.

In B.E 2481, POJ 2878, PS 14 and Bakhila species from Philippines were introduced in Lampang and Uttradit provinces. In B.E. 2499 NCO 310 was introduced, in cooperative with Agricultural Department of America, in Chonburi and spread around Thailand especially in the central such as Ratchburi, Kanchanaburi, Nakornprathum, Suphanburi and in the east such as Chonburi and Rayong. Now Thailand has more than 200 sugar species.

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2.6.1.3 Botany Characteristics

Sugar scientific name is Saccharum officinarum. It is in Gramineae family and high stem composing of joints and a segment of many-jointed stem. Leaf is composed of outer layer, and leaf sheet. Flower has a long bunch axle and branch put off. Small flowers paired off as one flower has a long axle and the other hasn't.

2.6.1.4 Chromosome of Sugar cane

Saccharum officinarum has chromosome 211 = 80. Of all Saccharum sp, S. officinarum has constant chromosome. Saecharum Spantaneum has chromosome between 32-128. Compound cane of these 2 species has all chromosomes from mother and half from father. Anueploid is the in crease or decrease of chromosome solidly but can live with a few flowers or no flower. This study is concerned to the number of compound chromosome because flowerless sugar cane is useful for growing in Thailand due to a number of sugar isn't lower when flowering.

2.6.1.5 Essential Food Element of Sugar

The most three essential food elements are Nitrogen, Phosphorus and Potassium which have the following main duties.

1. Nitrogen its duties are to help sugar cane to grow fast and leaves become bright-green if soils lose of Nitrogen, cane will be stunted, leaves are faded yellow, low yield. In case of over taken Nitrogen, cane will grow very fast and easily to bent when hit by air stoma or tractor, weak, less resistant to disease and insects and put off branches inevitable effected to sugar.

2. Phosphorus is essential to root and tuber. When combining with Nitrogen will create protein in younger plant and make cell-separation be better. In case of lose of phosphorus, a segment of many-jointed stem will be short, small, long top, less clumps put off, have only the first series 2-3 and tuber in these series will have no cane, have short root, small narrow leaf, old leaf will have dry top and rim.

3. Potassium Sugar canes need more potassium than other plants. Potassium make starch and sugar for canes, assist in compounding, create protein, make cell round and strong. If lose of potassium, plants will grow slowly,

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stem is small, Leaf become orange yellow and light green spot. This spot will be brown and make leaf be brown and dry like blight leaf. (Project Assessment and Evaluation Division : 1979)

2.6.1.6 Plantation Season

1. Early rainy season is from January to March in the irrigation area are from March to May if depend on rain.

2. End rainy season is grown *Kham Laeng* Sugarcane during October to November in the loose-sand soil area.

Soil Preparation

If the soil density at the depth level 50 centimeter is greater than 1.6 gram per cubic centimeter or after pulling down for soil preparation to renew must plough to quarry soil at the depth level 50-75 centimeter. If soil has organic object lower than 1.5%, any practice can perform.

1. Sow and improve soil by any of the following striped crotalaria, African sesbania 3 kg/rai, vignasinesis, Angola Pea, mung bean 5kg/rai or Jack Bean 10 kg/rai and plough in post mergence period of after harvest from improving soil

2. Sow organic fertilizer of manure deco posited 1,000-2,000 kg/rai

3. Put filterdecake 5,000-8,000 kg/rai except for soil pH greater than 7.5

4. Put dry bagass 2,000 kg/rai to improve soil structure.

Sow 1-2 times at 30-50 centimeter depth, dry soil 7-10 days If grew in early rainy season, loosen 1 time but if grow in the end of season loosen 2-3 times until soil loose and harrow remains, root, stem, tuber and weed from farm land soil at plain or irritation area should slope down 1 percentage.

The following table are detailed pathogens, symptom and pesticides for sugar canes disease.

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Table 2-1 Pathogens, symptoms and pesticides applied to sugar cane

Pathogens/Disease	Symptoms and its spread	Pesticides
1. White spot - Phytoplasma	- occur throughout sugar cane growth especially in pre mergence (numerous clumps of white leaf, sprout will not grow to stem) - stunt stem has top leaf spot or small sprout put off at lateral eyes of stem -disease spread into genetic stem and Mango Leafhopper act as a carrier.	-Gyphosate1 %
2. Black Stripe - Ustilago scitaminea sydow	- sugar cane put off the black top. - stunt stem has no stalk or small thin stalk or dry stalk the severity is rather on stunt stem than planted cane.	- Triadimefon 25% - Propiconazole 25%
3. Red rot - Collectotrichum fslcstum	- Stem red rot with white interval spot. Rot blight will become - Yellow leaf, yellow top, stem rot and clump finally died	- Benomyl 50% - Thiopanate - Methyl 70%
4. Wilt disease - Cephalosporium sp. and Fusariumsubglutinans	- Yellow leaf, dry leaf end, root system rot, top wilt, rot spread around and finally died.	- Benomyl 50% - Thiobenazole 90%
5. Pineapple disease - Thieaviopsis paradoxa	- within genetic stem rot, red and smell as ripe pineapple - pulp dry and rot, fall down and roomy, stem rot before eyes put off as sprout	- Triadimefon 25% - Propiconazole - Benomyl 50%

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Table 2-1 pathogens, symptoms and pesticides applied to sugar cane (Cont.)

Pathogens/Disease	Symptoms and its spread	Pesticides
6. Mosaic - Sugarcane Mosaic Virus	- leaf chlorophylls reduce and mosaic stripe clearly -The weak genetics will have mosaic appeared on stem peel, growth decline and stalk is lean.	- No chemicals applied but protect by choosing complete genetics stem
7. Yellow spot - Mycovelosiella koepkei	- Yellow spot appeared as needle tip and spread around to the top of sugar cane. Blight will turn to red or red brown.	- No chemicals applied but protect by choosing resistant genetics stem e.g. Uthong 2
8. Common rust - Pucinia melanocephala	- Disease will damage younger leaf to become to red spot and red brown spot accordingly swelled blight appeared at back leaf.	- No chemicals applied but choose resistant genetics stem
9. Pokkah boeng - Fusarium moniliforme	- younger leaf bottom at the top is whitish, shorten stuff, short leaf - when disease severely, top rot , turn to red brown and stem finally died. Severances occur during the rainy season.	- No chemicals applied but choose resistant genetics stem
10. Top rot / Red stripe - Pseudomonas rubrillineans	- Top rot of sprout , leaf red stripe stretchy - When raining, disease will spread and damage top and stem rot with bad smell and died at last.	- Antibiotics Terramycin + Streptomycin

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Table 2-1 pathogens, symptoms and pesticides applied to sugar cane (Cont.)

Pathogens/Disease	Symptoms and its spread	Pesticides
11. Bacteriosis - Erwinia sp.	- clear rot symptom in the internode development period, yellow leaf, top dry and clumps die. - stem rot, bad smell stuff and sometime fall down roomy	- Metalaxyl &Mancozab 8+64%
12. Pythium root rot - Pythium spp.	- Yellow leaf dry from top to bole starting from bottom to upper leaf - cane rot turn to brown or black and dry root die at last	- Metalaxyl& Mancozab 8+64%
13. Root, sheath and basal stem rot - Marasmiellus sp., Marasmius stenophylus	- damage sprout of sugar cane, make yellow leaf, outer layers of leaf stick to stem, disease damage into sprout stuff, some root rot, become brown and lessen - In humid climate, disease will develop mould put off outer layers of leaf and root on the ground	- No chemicals applied but improve soil for water exposure without store water in the rainy season

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Co-Operatives, B.E. 2547

Apart from disease, insects are one of the critical pests damaged on the sugar cane produces as the following descriptions in Table 2-2.

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Table 2-2 Insects, their destroyed characteristics and pesticides applied to sugar cane

Insects	Destroyed Characteristics	Pesticides
- Rodents (Bandicota indica, Bandicota savilei, Rattus rattus, rice field rat(Rattus argentivenger), Rattus losea, Ryukyu mouse, Fawn-coloured mouse)	- cutting all growth stage of sugar cane especially at age 6-8 month - cutting basal stem and root, make cane broken down	- Zinc phosfide - Flocumafen - Bromadiolon (0.005%) - Difethialone
- Stem-boring Grub, Dorysthenes.(Lophosternus) buqueti Guerin)	- cutting root and sprout, make stem roomy, dry clumps die and damage throughout growth stage of sugar cane	- Fipronil (5% SC)
- Stem Borers(Chilo tumidicostalis)	- maggot pierce top of stem and cut from its stuff to basal stem and remain only peel	- Nuclear Polyherosis Virus(NVP) - Beta-Cyfluthin(25% EC)
- Early Shoot Borer(Chilo infuscatellus Snellen)	- pierce basal sprout level on the ground - cut the growth parts and make top die	- Cypermethrin 25% EC) - Detamethrin (3% EC) - Broconids Tricosesia* - Beet army worm Cotesia*

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Table 2-2 Insects, their destroyed characteristics and pesticides applied to sugar cane

Insects	Destroyed Characteristics	Pesticides
- Termite, Coptotermes gestroi Wasmann, Coptotermes	- damage stem below the ground, make cane roomy cut sugar - damage throughout the growth stage of sugar cane	- Fipronil (5% SC)
- Sugarcane White Grub, Lepidiota stigma (Fabricius)	- cut root and make all clumps die - make canes broken down	- Fipronil (5% SC)

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Co-Operatives, B.E. 2547

Remark: * Natural substances

2.6.2 Maize

2.2.6.1 Maize Importance

Maize or Corn, Zea may L. is one of the most important economic cereal crops in Thailand. They are used as human food since Christopher Columbus found America in 1492. After that they spread into Europe, Asian an Africa. Of all cereal crops, maize is raked in the third of important World crops next to Wheat and Rice. They are generally harvest in humid temperature, subtropic and lowland tropic. Maize can well adjust to the environment from latitude 55 north degree to 40 south degree. The plantation field is 18% and 25% of world cereal produces which 15% are from Asia and Pacific Area.

2.6.2.2 History of Maize for Husbandry

Maize grew in Thailand was introduced by Portuguese merchant over 400 years ago. Maize has inevitably degenerated due to cross reproduction and nature selection. Nevertheless, considering to domestic produces, the plantation area of each province has annually increased as shown in Table 2-3.

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Table 2-3 Plantation Area of Maize by provinces during harvest period in 1989/90-1999/2000

Provinces	Plantation Area (rai)									
	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543
Chiengrai	245,964	224,160	301,183	290,734	275,300	282,408	299,608	06,373	295,761	298,997
Payao	117,412	138,314	189,061	185,605	145,596	175,892	16,651	183,931	175,211	176,772
Lampang	29,769	26,422	26,664	22,892	27,312	28,051	26,432	28,417	25,924	26,081
Lampoon	15,351	8,475	10,634	8,942	14,677	18,665	9,462	27,531	24,243	24,838
Chiengmai	39,798	10,294	18,040	29,111	29,652	21,108	17,290	18,288	19,239	19,779
Mae Hong Son	3,480	3,015	2,620	5,610	386	2,656	2,251	1,986	2,052	2,160
Tak	474,275	357,671	368,641	360,764	360,451	374,177	362,578	61,675	424,295	430,770
Kampangpetch	464,410	357,529	357,375	313,148	299,176	318,670	243,356	283,114	193,914	198,042
Sukhothai	139,700	74,932	64,188	82,209	62,629	68,114	54,642	71,156	71,694	71,856
Prae	107,397	80,245	62,857	94,099	81,847	88,096	90,317	61,838	66,224	68,782
Nan	209,737	173,287	183,153	248,082	192,422	193,842	198,430	161,409	146,915	150,182
Uttardit	146,459	90,061	102,751	102,004	85,528	91,967	107,840	60,514	50,4901	50,192
Pitsanulok	287,992	230,394	246,775	234,592	266,588	271,166	273,589	288,169	241,742	244,024
Pichit	37,849	67,744	83,430	90,708	88,925	90,481	87,760	52,769	53,763	54,252
Nakornsawan	585,364	483,234	530,290	594,441	587,574	582,768	617,326	678,967	568,492	578,339
Uthaithani	443,492	342,321	253,061	265,759	169,778	237,915	295,597	284,111	276,492	279,548
Petchboon	1,052,129	1,181,260	1,091,359	1,177,653	1,368,971	1,386,870	1,216,404	1,278,696	1,087,774	1,106,859
Loey	979,249	834,433	660,601	663,946	681,634	696,416	713,032	686,255	541,535	544,365
Nong Buelampoon	-	-	-	103,754	123,002	125,324	133,656	113,564	101,714	104,627
Udorthani	234,332	231,978	198,097	97,979	80,571	82,391	86,270	89,520	54,029	55,840
Nongkay	-	316	193	-	-	-	-	1,945	1,508	1,604
Srisaket	170,411	156,265	140,979	133,715	123,544	130,738	129,568	134,029	119,811	120,663
Burirum	19,983	18,238	4,324	16,752	6,147	6,601	8,794	8,907	6,481	6,678
Kalasin	13,397	5,383	3,500	6,500	6,150	6,468	5,387	5,841	3,526	3,683
Konkaen	54,066	49,573	25,600	27,489	29,565	30,432	19,694	24,736	12,390	12,454
Chaiyaphum	346,897	290,259	232,028	229,019	242,300	269,113	281,413	301,791	264,303	265,656
Nakornratsima	650,657	880,315	933,980	1,033,184	875,064	952,916	1,072,363	1,109,867	981,501	967,932
Saraburi	246,021	204,544	319,739	297,858	259,079	263,895	255,067	251,196	265,050	265,451
Lopbuir	717,306	640,300	634,421	819,789	697,849	710,778	713,117	612,370	616,244	-
Chainat	21,130	17,499	23,410	21,714	27,014	28,327	1,523	36,376	30,314	31,238
Suphanburi	52,187	74,588	81,912	89,676	77,37	100,589	112,743	134,768	114,343	111,353
Prachinburi	555,141	553,331	592,881	44,605	67,028	74,232	82,236	84,156	69,605	71,383

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Table 2-3 Plantation Area of Maize by provinces during harvest period in 1989/90-1999/2000 (Cont.)

Provinces	Plantation Area (rai)									
	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543
Chacheongsao	26,679	16,716	17,257	19,872	39,268	38,648	41,078	43,637	40,664	42,399
Srakaew	-	-	-	550,009	542,565	556,114	638,795	651,799	536,146	538,747
Chanthaburi	181,933	176,571	136,578	159,100	112,234	77,937	117,114	117,427	94,411	95,060
Chonburi	-	6,478	5,821	5,380	4,795	5,114	5,773	6,717	2,523	2,497
Kanchanaburi	156,137	153,682	162,979	167,114	127,894	141,198	136,972	152,174	143,730	147,443
Ratchburi	123,765	81,516	68,093	46,402	33,830	41,601	25,500	17,346	19,164	19,251
Petchburi	34,129	32,293	49,093	41,106	35,220	38,238	29,731	21,265	19,140	19,856
Prachubkirikhan	29,682	27,236	16,900	14,015	10,128	9,121	9,409	9,339	4,612	4,596
Chomporn	106,876	110,324	134,949	99,483	64,279	20,131	11,823	11,047	6,375	6,477
Surajthani	5,796	4,214	4,952	6,926	-	-	1,057	1,248	1,611	1,738

2.6.2.3 Species and Botany of Maize

Botany characteristics of maize can be classified in the following orders.

- Family Gramineae such as varieties of glass and cereal crops
- Sub family Panicoideae such as maize, sorghum, genus Coix and sugar cane etc.
- Tribe Maydeae is classified into 7 Genus namely Coix, Chionachne, Schlerachne, Trilobachne , Polytoca

The first 5 Genus originated in Asia and the next 2 Genus is Zea and Tripsacum which derived from America. The important characteristics of this tribe are the separation of masculine and feminine flower in monoeciouus.

genus Zea

species mays

2.6.2.4 Botany of Maize

1) Root When planting seeds, root is firstly come out before any parts starting from embryo to tuber or stem that grew in reverse to root. At the same time, the secondary and third root will sprout accordingly. Those aforesaid root is a primary or seminal root After 7-10 days grown, adventitious root or permanent root

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will come out around joints. At the deep of 3-5 centimeter, aerial or brace roots are included in this adventitious root or permanent root.

When the permanent root has extremely grown, it would spread around about 100 centimeter and sound stretched vertically into the ground; may be at 300 centimeter. At the beginning, the permanent root will rapidly grow. As experiment, that root will grow at 60 centimeter within 28 days. Once maize is blossoming and earring, root will reduce its spreading out and growth, respectively. Maize also stop earring when aged. The aptitude of root penetration is based on soil type, soil humidity and water level below the ground.

Maize root also has fibrous root system which has a variety of classification such as primary root, brace root, lateral root and root hair but no tap root. Primary root is firstly sprout at 20-30 roots. Brace root has an infinite number and can divide into a hundred numerous sub-root with 30-60 centimeter length. Fibrous root is very tiny and has short life. A research was founded that root weight equals to 12 percentage of gross weight. The number of maize root of each species is varied according to heredity.

The following tables are presented the pathogens, symptoms and pesticides in Table 2-3 and presented the insects, their destroyed characteristics and pesticides applied to maize in Table 2-4.

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Table 2-4 pathogens, symptoms and pesticides applied to maize

Pathogens/Disease	Symptoms and its spread	Pesticides
Leaf Stripe Disease - Peonosclerospora sorghi	- spread into 1 month younger plant - Top has frequent jointed, stunt stem, leaf white stripe with light green or light yellow along leaf length, if spread more, stem will die	- Taolaxil (35% DS)
Common rust - Puccinia polysora Underw	- occur at all maize parts. First, 0.2-1.3 mm. of swell blight brown spot was found - Common rust blight appear. In case of strong severity, maize will die.	- No chemicals applied but protect by choosing resistant genetics stem
Blight Leaf Spot - Bipolaris maydis Nisik & Shoemaker	- firstly small wet light green spot appearet - Blight spread along leaf lines, blight burn with ash blight in the center and brown frame	- Bacillus Subtilis

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Co-Operatives, B.E. 2547

Apart from disease, insects are one of the critical pests damaged on the maize produces as the following descriptions of Table 2-5.

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Table 2-5 Insects, their destroyed characteristics and pesticides applied to maize

Insects	Destroyed Characteristics	Pesticides
- Cutworm	- cut all parts of younger plants	- Nuclear Polyhero Virus(NPV) - Beta-cyfluthin(2.5% EC)
Cotton bollworm	- cut corn silk, pierce into tip pod and damage pod quality	- Nuclear Polyhydrosil Virus - Fluphennoxuron (5% EC)
Corn stem borer	- siphon nutrient top leaf, younger leaf, male inflorescence corn, tip corn silk and pod - incomplete seed -lean pod due to its dunk causing black spot	- Cabaryl (85% WP) - Bifenthrin (10% EC)
- Corn leaf aphid	- damage from 20 days younger maize to cultivation period by piercing into top, inflorescence and stem - stop stem growth and easily broken down	- Cytermethrin (15% EC) - Triflumuron (25% WP)
-Ground Weevil	-cut leaf from putting off to 14 day maize, make younger maize die or stop its growth	- Imidacloprid (70% WS)

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Cooperatives, B.E. 2547

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2.6.3 Cassava

2.6.3.1 History and its origins

Cassava was introduced in the South America in Peru, Mexico, Guatemala and Honduras. It assumed that cassava has been grown in Mexico for 21,000 years ago and in Peru for 4,000 years ago. After that, it was spread to tropical South Africa by Indian and to Asia by Portuguese and Spanish in mean of import to India, Sri Lanka, Malaysia and Indonesia in the seventeenth century.

There is no evidence to reveal when cassava introduced to Thailand. It has predictable that cassava was in Thailand at the same time as in Sri Lanka, Philippines around B.E. 2329-2383. In the earlier, it was called bitter cassava, sweet-potato-tree and now changed to manioc or tapioca (Department of Agriculture, 2526 : 1)

2.6.3.2 Its importance

Cassava is ranked in the fifth important world food next to wheat, maize, rice and potato. It is in tropic area especially in Africa and south America. In Asia, a lot of cassava was consumed in Indonesia and India. In 2001, they are produced at 139.827 million metric tons and 60% of them become human food, 27.5% for animal feed and 12.5% for any application.

Cassava is ranked in the fourth income next to Rubber, Sugar Cane and Rice. Its produce value in 5 year average (1998-2002) is 15,416 million baht. Domestic cassava root was transformed to cassava root and cassava tablet 40-50% and tapioca starch 50-55%. The transformed products can be exported at 18,803 million baht.

Thailand is the biggest world exporter for tapioca products. As those of major tapioca producer such as Nigeria, Brazil and others consume more tapioca products in their country, Thailand locally use them. Thailand export most of cassava tablet to countries in European Community Country (Netherland, Spain, Germany and Portugalete), south Korea and Japan. And, export tapioca starch to Japan, Hong Kong, America, Malaysia, Singapore and Taiwan, respectively.

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According to its importance, the researcher united the study of cassava with sugar cane and maize. However, pathogens/diseases and natural pest were founded and effected on cassava plantation as shown in table 2-6 and 2-7.

Table 2-6 Pathogens, symptoms and pesticides applied to cassava

Pathogens/Disease	Destroyed Characteristics	Pesticides
1. Cassava Bacterial Blight - Xanthomonas compestris pv. manihotis	- wet triangle leaf, blight, wilt, sap flow, top wilt and die - Vessel system of stem and root rot	- No chemicals applied but use sterilized genetics stem
2. Brown Leaf Spot - Cercosporidium ingsii	- found disease at lower leaf rather than upper leaf - leaf spot with slightly triangle along leaf lines, regular, 3-15 mm. brown - blight encircle by Yellow halo and in the center of blight is dry and roomy.	- Chemicals copper, benomy1
3. Blight Leaf Spot - Cercospora viscosae	- blight leaf wide spot with unlimited halo as Brown Leaf Spot, blight is 1 of 5 wide of fragment - regular brown blight with yellow halo is found on front side and grey halo is found at back side	- chemical group: copper, benomy1
4. White Leaf Spot - Phoeoramularia manihotis (Cercospora caribaea)	- triangle to 1-4 mm round spot, white blight with brown-purple frame and encircle by yellow halo -	- No chemicals applied but use resistant genetics
5. Stem Rot - Glimerilla cingulata	- Genetics stalk rot at tip and spread inside, making peel rot and wilt - black bottom peel and swell spot on upper peel and broken into powder called cingulata	- No chemicals applied but use resistant genetics stem

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Table 2-6 Pathogens, symptoms and pesticides applied to cassava (Cont.)

Pathogens/Disease	Destroyed Characteristics	Pesticides
6. Botryodiplodia theobromae - Glimerilla cingulata	- Vessel will rot and turn to black by spreading from blight genetics stem or blight stem - peel swell and rot in black-black color, have a pycinidia group of mould on peel and die	-Dip genetics stem with chemicals e.g. mancozeb, copper oxycholoride (400 ppm)
7. Cassava Ash Disease - Oidium manithotis	- white fiber cover leaf spot - irregular triangle spot as the damage of Red Spider Mites, found on the bottom leaf rather than younger leaf	- No chemicals applied but use resistant genetics stem
8. Anthracnose - Collerotricm (Gloeosporium) spp.	- Pale yellow leaf at leaf joint and leaf stem, found brown blight and sometime spread to leaf stem and cause leaf fall down at last - damage green stem and cause canker symptom, stunt stem and die	- No chemicals applied but use resistant genetics stem
9. Root and Tuber Rot Diseases - Pyhtophtora drechsleri - Rigidoporus (Fomes) lignosus	- occur with young stem, make brown root rot - stem wilt, if occur on tuber, it will rot quickly with bad smell, leaf wilt and fall down-	- both mould and bacteria cause a varieties of pathogen disease but there are many ways to protect and eliminate them such as preparation of farmland and choosing genetics stem

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Co-Operatives, B.E.2547

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Table 2-7 Insects, their destroyed characteristics and pesticides applied to cassava

Insects	Destroyed Characteristics	Pesticides
Red mites (Red Indian Mulberry) and red cassava Mites	- siphon nutrient under base leaves of cassava and reach to top - pale yellow stripe leaf, leaf wrap and fall down, Top twist, eyes lean	- Dicofol (Kethane 18.5% EC)
Mealy bug	- siphon nutrient from cassava parts - less light synthesizing, imperfect growth, steep joint of stem, top die or top clumps	- Malathio (Malathion 83% EC)
Whitefly, Dialeurodes sp.	- both nymph and adults siphon nutrient under leaf - insects will release fluid waste causing black mould spot sand, less light synthesizing, stop growth, leaf wrap pale and fall down	- omethoate (Ometoat 500 SL 50% SL)
Termite, Coptotermes gestroi Wasmann, Coptotermes spp.	- adults cut genetics stem till cassava cannot put off.	- Fipronil (5% SC)
Sugarcane White Grub, Lepidiota stigma (Fabricius)	- roots are cut and die. - damage young plant similarly as drought but stem easily to draw	- Fipronil (5% SC)
(Stem-boring Grub, Dorysthenes.(Lophosternus) buqueti Guerin)	- sprouts and tuber are cut by worm - stem fall down ahead	- Fipronil (5% SC)

Source: Field Crop Research Center, Department of Agriculture, Ministry of Agriculture and Co-Operatives, B.E. 2547

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2.7 Research concerns to economics, social and population determined the behavior of pesticide application

Supatsiri Pornsurat (2000) has studied the farmer realization on rice pesticide poison at Ampour Mueng, Suphanburi province. She founded that farmers at age average 45.7 year and gain primary grade 4 have experienced in using rice pesticide around 11-20 year, have experienced in danger of rice pesticide not over than 50%. Those have average knowledge of pesticide safety, more knowledge of its application and the top 3 majority knowledge in supervising the rice pest namely Pesticides store, Agricultural Extension Officer and Television.

Department of Agriculture (1995) has studied the farmer behavior and their interests in reduction of pesticides application and found that most farmers used to apply pesticides more than 1-10 years as well as select such chemicals from grocery seller's recommendations. They will read the chemical instruction before using them and will mostly use the pesticide to kill insects. If those insects resistant to the chemicals, they will replace with others.

Pramote Yamprom (1996) has studied the safety of pesticide application in daily live of volunteer housewives in Ampure Bangkruy, Nonthaburi province and found that those volunteer gain knowledge and aware of pesticides danger significantly at 0.05.

Saowanee Chaitheing (1981) has studied the people behavior of pesticide application in a crowned community of Kusolthong, Yannawa, Bangkok and found that those people gain knowledge of pesticides and its danger improperly and differently, depend on their occupation, monthly income, house state and surrounding, age and education level.

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Chothip Thantawee (1989) has studied the student perception and their awareness of pesticide application at Prathom 6 student houses in Ampure Mueng, Nakornprathom and found that the student perception and their awareness of pesticide application at Prathom 6 student houses has a positive relation and average of correlation coefficient at 0.31.

Nittaya Suriyacharoeng (1980:86) has studied the farmer behavior in applying of pesticide in Ampure Ban Praew, Sumutsakorn province and found that farmer having Prathom 4 or lower can use of pesticide most properly and next are those Prathom 5-7, Mathayomsuksa 1-3 or higher, respectively.

In addition, farmers having monthly income less than or equal to 150,000 baht will use pesticide most properly and next are those having income greater than 250,000 baht and 150,000 – 250,000 baht, respectively.

Cherdsak Chalueaysilp (1998) referred to Vatit Buasaeng (1988:71) has studied some problems in applying pesticides of farmer who grow vegetables in Ampure Mueng, Nakornsithamarat province and found that farmer pesticide application has a negative relation with their age.

Pornnipa Srisuwattansakul (1988) has studied the practices in applying pesticides of farmer who grow vegetables in Tambon Bangbuathong, Ampure Bangbuathong, Nonthaburi province and found that farmers having difference size of farmland have difference behavior in using pesticide.

Cherdsak Chalueaysilp (1998:52) referred to Vut Ninkaew has studied the knowledge and attitude of people on growing of forest in Ampure Sanka, Surin province and found that people tenure lands less than or equal to 10 rai have better attitude in growing forest than those tenure lands greater than 10 rai. Land tenure is also impacted on knowledge of soil and water reservation.

Nuaysiri Paorohit (1990:56) said that human perceive only some of all experienced stimulus objects and will interpret and respond to such an object one by one.

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CHAPTER III
RESEARCH METHODOLOGY

The research aims at studying of farmer's behavior in applying chemical pesticides in field crops of cassava, sugar can and maize at Chainat and Suphanburi provinces is survey research with questionnaire. The case study is focus on the farmer application of chemical pesticides for cassava, sugar cane and maize at Chainat and Suphanburi provinces. The research guideline, data collection and data analysis the researcher

3.1 Target Group

Target group in the study is the farmer planting cassava, sugar cane and maize at Chainat and Suphanburi Provinces who run their activities as landlord or renter and raise their income from field crops of sugar cane, cassava and maize. Upon inspection farmer data from Provincial Agriculture Office both Suphanburi and Chainat Provinces, the target group areas are tabulated in Table 3-1.

Table 3-1 Farmer Planting Sugar Cane, Cassava and Maize at Chainat and Suphanburi Provinces Distributed to District

Province	District	No. of Farmer of Sugar Cane (Person)	No. Farmer of Cassava (Person)	No. Farmer of Maize (Person)
Chainat	1.Nong Mah Mong Sub-District	114	228	310
	2. Wat Singh	8	271	7
	3. Manorom	0	0	51
	4. Subphaya	1	0	0

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Table 3-1 Farmer Planting Sugar Cane, Cassava and Maize at Chainat and Suphanburi Provinces Distributed to District (Cont.)

Province	District	No. of Farmer of Sugar Cane (Person)	No. Farmer of Cassava (Person)	No. Farmer of Maize (Person)
	5. Sankhaburi	120	0	0
	6. Hankha District	141	1,623	46
	7. Noen Ngam Sub-District	1,227	697	88
	Total	1,611	2,819	502
Suphanburi	1. Dan Chang	6,420	5,122	402
	2. Dermbang Nangbuat District	2,463	560	132
	3. Nong Ya Sai	1,842	781	340
	4. Sam Chuk	44	0	0
	5. Don Chedi	312	112	0
	6. Sriprajan	117	64	13
	7. Muang District	64	0	0
	8.U-Thong	4,113	1,134	293
	9. Bang Plama	0	0	2
	10. Song Phee Nong District	926	547	18
	Total	16,301	8,320	1,200
Grand Total		**17,912**	**11,139**	**1,702**

Reference : Provincial Agriculture Office of Chainat and Suphaburi Province, B.E. 2549

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3.2 Random Sampling and Population

3.2.1 Determination of Population Size Suitable size of population in the research is determined by the formula for sampling size of Taro Yamane referred in Prakhong Kanasute (B.E. 2522:13)

$$n = \frac{N}{1+ N(e)^2}$$

e = Deviation of target group
N = Population size
n = Size of sample group

Where as N = Total sampling
e = Deviation of population (0.10)

Significant deviation of the study is equal to 0.10. As the general study, the deviation is accepted from 0.01, 0.05 to 0.10 of which are the acceptable criteria of qualitative research.

Based on sampling group, the study is distributed according to kind of field crops.

3.2.1.1 Farmer Planting Sugar Cane

$$n = \frac{17912}{1+ 17912\ (0.10)^2}$$

n = 99.44 ~100 persons

3.2.1.2 Farmer Planting Cassava

$$n = \frac{11139}{1+ 11139\ (0.10)^2}$$

n = 99.11 ~100 persons

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3.2.1.3 Farmer Planting Maize

$$n = \frac{1702}{1+ 1702\ (0.10)^2}$$

$$n = 94.45 \quad \sim 95 \quad \text{persons}$$

3.2.2 Random of Sampling The study is based on survey research with questionnaire and structure interview. The survey is conducted with accidental sampling that the population is not focused only on each study area. But the sampling is systematically conducted in distribute to various of study areas.

3.3 Research Tool

3.3.1 Interviewing with Questionnaire

The research is carried out with structure interview with questionnaire. Questionnaire design is based on documents and related research for preliminary guidelines comprising of 5 parts.

Part 1 Questions on personal data namely gender, age, educational level, annual income, size of farmland and characteristics of land tenure

Part 2 Questions on stimulating factors and general factors e.g. knowledge and information of GAP (Good Agricultural Practice) on field crops planting. Trained for information on chemical pesticides application, knowledge of pesticides danger, knowledge and training for organic farming.

Frequency of information received in respected of chemical pesticides application is relatively categorized with 4 levels as following

Never	0	Score
Rarely(once a month)	1	Scores
Usually (3-4 times/month)	2	Scores
Everyday	3	Scores

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Scores rating from information received on chemical pesticides application will enable new factor and then be categorized. Criteria of obtaining information of the population is divided into 3 levels as follows.

Score	Level of Obtaining Information
0 - 33 % (9 Scores and less)	Low
34 – 67(10 – 18 Scores)	Medium
68-100% (19 Scores up)	High

Part 3 Questions concern knowledge test of chemical pesticide application with 2 levels: Yes, No with following criteria

Right Answer 1 Score

Wrong Answer 0 Score

Points from chemical pesticide application are taken to enable new factors and then categorized with knowledge of population into 3 levels.

Scores	Level of Knowledge
0 - 33 % (4 Scores and less)	Low
34 – 67% (5-8 Scores)	Medium
68-100% (9 Scores up)	High

Part 4 Questions on chemical application danger are applied with 2 levels: Yes, No as following criteria

Right Answer 1 Score

Wrong Answer 0 Score

Points	Level of Knowledge
0 - 33 % (4 Scores and less)	Low
34 – 67% (5-8 Scores)	Medium
68-100% (9 Scores up)	High

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Part 5 Questions about behavior of chemical pesticide application are induced with positive and negative aspects. With statistical interpretation, series of questions will covered with 4 characteristics: behave every time, behave usually, behave sometimes and never . Determined criteria for questions are as follows:

Positive questions are question no. 1 2 3 4 5 7 9 10 11 12 13 14 15 17 19

Behave every time	rate	3	Points
Behave usually	rate	2	Points
Behave sometimes	rate	1	Point
Never	rate	0	Point

Positive questions are question no. 6 8 16 18

Behave every time	rate	0	Score
Behave usually	rate	1	Score
Behave sometimes	rate	2	Scores
Never	rate	3	Scores

Criteria for analyzing the scores of behavior on chemical pesticides application onto their level

Points	Behavior Level
0 - 33 % (14 Scores and less)	Low corrected
34 – 67% (15-29 Scores)	Medium corrected
68-100% (30 Scores up)	High corrected

3.4 Tool Design and Development

Steps for tool design and development of the study will be following

Step 1 Determination of Interview Context Questions are determined in respect of details and series of data from documents and related research

Step 2 Question is divided into 2 characteristics: opened end question and closed end question according to the determined context. After that the discussion with thesis committee is required for amendment and completeness.

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Step 3 Pre-Test of questionnaire Questionnaire shall be conducted for pretest with population in the study area at Nakhornpathom Province who plant field crops(sugar cane, cassava and maize). For the reason that the area is the place where running activities is similar to population and situated in Tha Chin River Basin. The operation is conducted with 20 set of questionnaires for primarily test for question understanding and inspect its deficiency prior to actual application in the study area.

Step 4 The questionnaire is improved by the researcher after pretest and finally inspected by thesis committee prior to data collection.

3.5 Tools Development

3.5.1 Validity Tools to be applied in the study are developed by the researcher based on related documents, research and then are preliminarily inspected by thesis advisor for improvement on content validity. In addition. The tools are further improved according to thesis advisor and specialist before actual application.

3.5.2 Pretest Questionnaires are applied for pretest with 20 farmers in Nakhornpathom Province. The operation is conducted for recheck pretest sampling population on understanding of research objectives and experience the problem on interview. Moreover, the derived elementary results will be the guidelines for amendment to questionnaire completeness.

3.6 Data Analysis and Statistic

Primary data collected from questionnaire will be reinspected and then assessed with SPSS for window and calculated with statistical appliance

3.6.1 Generic sampling population will be presented in description in related of features and characteristic, quantity, frequency and data distribution. Statistical assessment is applied with percentage and SD

3.6.2 Relation analysis of an independent factor and dependent factor with interval measurement is applied with One – Way Analysis of Variance.

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CHAPTER IV
RESULTS AND DISCUSSIONS

The research is to reveal the farmers' behavior in applying chemical pesticides in field crops of cassava, sugar cane and maize at Chainat and Suphanburi provinces. The survey has been exercised by questionnaires. Based on the sampling in Chapter 3, there are totally 295 samplings But, due to a field study constraints 278 sets of questionnaires were conducted and collected from 150 of sugar cane farmers, 51 of cassava farmers and 77 of maize farmers, respectively. Those of sampling quantity are not comply to the ratio of farmers number who grow such crops in those area according to the environment of field study in collecting the real database. The research outcome can be concluded as follows:

1. General Data of Informant Farmers
2. Stimulating Factor and Environmental Factor
3. Knowledge of Chemical Pesticides Application of Informants
4. Knowledge of Chemical Pesticides Danger of Informants
5. Behavior in applying Chemical Pesticides of Informants
6. Problems in applying Chemical Pesticides of Informants
7. Research Hypothesis Testing

4.1 General Data of Informant Farmers

Based on general data of informant farmers, most informants are male (62.59%) with 31-50 years old (61.87%) and average 46.76 years old. They graduated in Senior Secondary School most (47.84%) and next in Junior Secondary School (36.33%). They earn their living by field crop with not more than 100,001 Baht/Year. The longest period for occupation in agriculture is not more than 10 years (46.40%) run in farmland of 6-20 rai (50.00%). Most of them use labor for agriculture less than

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11 persons (85.25%). Labor used can be identified as of labor from household member 1-5 persons most (92.81%) and labor from employment less than 11 persons (41.37%). Application of pesticides is mostly conducted from labor outside household (37.41%) and next is self agriculturist (35.61%) and labor in household (25.54%).

Farmland area engaged most is 1 plot (68.35%) and next is 2 plot (20.14%). The greatest area is less than 11 rai (46.04%) and next is 11-20 rai (28.42%), whereas most are landlords (68.70%). The field crops plant most is sugar cane (53.96%), secondly is maize (27.70%) and the last is cassava (18.34%). Most produces are directly sold to factories or industrial company according to farmers have signed the contract or quota with those of them. The description of research outcome are presented in Table 4-1.

Table 4-1 General Data of Informant Farmers

Description	**Number (n = 278)**	**Percentage**
Gender		
Male	174	62.59
Female	104	37.41
Age		
> 20 years	4	1.44
21 - 30 years	12	4.32
31 - 40 years	75	26.98
41 - 50 years	97	34.89
51 - 60 years	54	19.42
> 60 years	36	12.95
youngest informants 20 years		
oldest informants 79 years		
average aged 46.76 years		

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Table 4-1 General Data of Informant Farmers (Cont.)

Description	Number (n = 278)	Percentage
Education Level		
Not learn	4	1.44
Junior Primary School	101	36.33
Senior Primary School	133	47.84
Junior Secondary School	15	5.40
Senior Secondary School	20	7.19
Junior Certificate	3	1.08
Senior Certificate	1	0.36
Bachelor Degree	1	0.36
Annual Income from Occupation in planting field crops (in the last year)		
> 50,000 Baht	94	33.81
50,001 - 100,000 Baht	103	37.05
100,001 - 200,000 Baht	49	17.63
200,001 - 300,000 Baht	12	4.32
300,001 Baht up	20	7.19
Period of Occupation		
Duration		
> 11 years	129	46.40
11 – 20 years	88	31.65
21 – 30 years	48	17.27
< 30 years	13	4.68
longest period 50 years		
shortest period 1 years		
average period 15.61 years		

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Table 4-1 General Data of Informant Farmers (Cont.)

Description	Number (n = 278)	Percentage
Area Number		
> 6 rai	55	19.78
6-10 rai	82	29.50
11-20 rai	57	20.50
20 rai up	84	30.22
Agricultural Labor		
Labor from Household Member		
None	2	0.72
1 – 5 persons	258	92.81
< 5 persons	18	6.47
greatest labor 11 persons		
smallest labor 1 persons		
average labor 2.77 persons		
Labor from Employment		
None	138	49.64
> 1 person	115	41.37
11 – 20 persons	19	6.83
< 20 persons	6	2.16
greatest labor 100 persons		
smallest labor 1 person		
average labor 7.89 persons		
Total Labor		
< 11 persons	237	85.25
11 – 20 persons	29	10.43
21 – 30 persons	8	2.88
> 30 persons	4	1.44

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Table 4-1 General Data of Informant Farmers (Cont.)

Description	Number (n = 278)	Percentage
greatest labor 100 persons smallest labor 1 persons average labor 6.73 persons		
Applicants of Pesticides		
Labor from Household Member	71	25.54
Self Agriculturalists	99	35.61
Labor from Employment	104	37.41
Labor from Household Member and Self Agriculturalists	2	0.72
Labor from Household Member and Labor from Employment	2	0.72
Farmland Area		
Farmland Number		
1 plot	190	68.35
2 plot	56	20.14
3 plot	22	7.91
4 plot	6	2.16
5 plot	1	0.36
6 plot	2	0.72
7 plot	1	0.36
average 1.49 plot		
Size of Farmland		
>11 rai	128	46.04
11 – 20 rai	79	28.42
21 – 30 rai	25	8.99
31 – 40 rai	18	6.48
< 40 rai	28	10.07

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Table 4-1 General Data of Informant Farmers (Cont.)

Description	Number (n = 278)	Percentage
greatest area 300 rai		
Smallest area 1 rai		
average area 22.00 rai		
Land Tenure for Agriculture		
Landlord	191	68.70
Land Tenement	50	17.99
Landlord and Land Tenement	37	13.31
Field crops grew in Farmland		
Maize	77	27.70
Sugar cane	150	53.96
Cassava	51	18.34
Produces Selling or Distribution*		
Trader agents directly buy from farmland	87	31.29
Directly to industrial company or factory	173	62.23
Export	1	0.36
Trade as retails or whole sell	17	6.12

Remark *can answer more than 1 topic

4.2 Stimulating Factor and Environmental Factor

4.2.1 GAP (Good Agricultural Practice) Process of Farmers

Almost all informants do not know GAP (94.60%) while the rest know GAP (5.40%) by suggestions from neighbor and associated club member most (53.34%). Informants who know GAP used to gain GAP knowledge for planting (80.00%) by received information most (84.98%) and next is from government officers (58.33%). The GAP has been applied in the farmland of those informants, who know GAP (60.00%) as detailed in Table 4-2.

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Table 4-2 GAP (Good Agricultural Practice) Process of Farmers

Description	Number (n = 278)	Percentage
Know GAP (Good Agricultural Practice)		
Yes	15	5.40
No	263	94.60
Advisor of GAP (Good Agricultural Practice) (n = 15)		
Neighbor/ associated club member	(5)	(33.33)
Government officers	(8)	(53.34)
Educational institute	(2)	(13.33)
Knowledge of GAP (Good Agricultural Practice) for planting (n = 15)		
Familiar	(12)	(80.00)
Unfamiliar	(3)	(20.00)
Educator of GAP (Good Agricultural Practice) for planting (n = 12)		
Neighbor/ associated club member	(3)	(25.00)
Government officers	(7)	(58.33)
Educational institute	(2)	(16.67)
Applied on GAP (Good Agricultural Practice) for planting (n = 15)		
Yes	(9)	(60.00)
No	(6)	(40.00)
Causes to apply GAP (Good Agricultural Practice) for planting (n = 9)		
Be a farmer model	(5)	(55.56)
Gain favorable outcome after applied	(3)	(33.33)
Can save cost after applied	(1)	(11.11)

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Table 4-2 GAP (Good Agricultural Practice) Process of Farmers (Cont.)

Description	Number (n = 278)	Percentage
Causes to not apply GAP (Good Agricultural Practice) for planting (n = 6)		
Unready due to under studying	(3)	(50.00)
Do not understand	(1)	(16.67)
Gain unfavorable outcome after applied	(2)	(33.33)

4.2.2 Information received on Pesticides Application

Almost all informants used to receive the information on pesticides application (98.20%) by receiving at the low level most (84.98%) and next is in the medium level (14.65%) as detailed in Table 4-3

Table 4-3 Information received on Pesticides Application

Description	Number (n = 278)	Percentage
Information received on Pesticides Application		
Familiar	273	98.20
Unfamiliar	5	1.80
Frequency in receiving Information on Pesticides Application (n = 273)		
Low	(232)	(84.98)
Medium	(40)	(14.65)
High	(1)	(0.37)

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4.2.3 Participation in Training on Pesticides Application of Informants

Most of informants have not been participated in training on pesticides application (70.86%) while the rest did (29.14%) regarding the following topics. 1) Prohibit Chemicals/Chemicals (49.38%) 2) Biotic/Organic/Effective Microorganism Fertilizer (49.38%) 3) Chemical residues (7.41%) 4) Export plantation (1.23%) and 5) Planting of rotation plants (1.23%) as shown in Table 4-4.

Table 4-4 Participation in Training on Pesticides Application of Informants

Description	Number (n = 278)	Percentage
Participation in Training on Pesticides Application		
Familiar	197	70.86
Unfamiliar	81	29.14
Training Topics involved and Organizer related on Pesticide Application (n = 81)*		
Chemical Residues	(6)	(7.41)
organized by (n = 6)		
Chief of District Agricultural Extension Office	(5)	(83.33)
Chief of District Public Health Office	(1)	(16.67)
Prohibit Chemicals/Chemicals	(40)	(49.38)
organized by (n = 40)		
Chief of District Agricultural Extension Office	(29)	72.50)
Chemical Manufacturer/Distributor	(7)	(17.50)
Director of Provincial Agricultural Extension Office	(4)	(10.00)

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Table 4-4 Participation in Training on Pesticides Application of Informants (Cont.)

Description	Number (n = 278)	Percentage
Biotic/Organic/Microorganism Fertilizer organized by (n = 40)	(40)	(49.38)
Chemical Manufacturer/Distributor	(5)	(12.50)
Agricultural University	(2)	(5.00)
Chief of District Agricultural Extension Office	(21)	(52.50)
Land Development Department	(7)	(17.50)
Director of Provincial Agricultural Extension Office	(5)	(12.50)
Export Plantation organized by (n = 1)	(1)	(1.23)
Export Company	(1)	100.00)
Planting of revolution plants organized by (n = 1)	(1)	(1.23)
Chief of District Agricultural Extension Office	(1)	(100.00)

Remark *Can answer more than 1 topic

4.2.4 Applied Chemical Pesticides of Informants

Informants buy chemical pesticides from grocery shop most (87.77%) next is from cooperative/community (9.35%) Most of them apply chemical pesticides less than 11 years (55.75%) by never got harmful or accidents from pesticides (85.25%) and never got sick from pesticides (79.50%) Almost of informants know its danger (98.20%) and put on equipments to protect themselves before mixed or spayed such chemicals (98.92%) such as 1) long sleeves shirt/trousers (99.27%) 2) glasses (26.18%) 3) hat (94.18%) and hand gloves (61.09%) In addition, they regularly clean the containers and equipments applied for

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pesticides by using plain water, detergent, dish drop, soup water, vinegar and chemical solution as shown in Table 4-5.

Table 4-5 Applied Chemical Pesticides of Informants

Description	Number (n = 278)	Percentage
Sources of Chemical Pesticides Distribution		
Shops	244	87.77
Trading Agents	3	1.08
Cooperative/Community	26	9.35
Company/Factory	5	1.80
Period applied Chemical Pesticides		
< 11 years	155	55.75
11 – 20 years	74	26.62
21 – 30 years	40	14.39
< 30 years	9	3.24
longest period 45 years		
shortest period 1 year		
Average period 13.97 year		
Get danger or accidents from chemical pesticides		
Yes	41	14.75
No	237	85.25
Get sick from chemical pesticides		
Yes	57	20.50
No	221	79.50
Sick symptom from chemical pesticides (n = 57)		
Intoxicated	(20)	(35.09)
Tried	(2)	(3.51)
painful along body	(2)	(3.51)
Itch along body	(1)	(1.75)
Vomit	(32)	(56.14)

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Table 4-5 Applied Chemical Pesticides of Informants (Cont.)

Description	Number (n = 278)	Percentage
Know danger in applying chemical pesticides		
Yes	273	98.20
No	5	1.80
Put on protective equipments before mixed or spayed chemical pesticides		
No	3	1.08
Yes	275	98.92
Protective equipments applied before mixed or spayed chemical * (n = 275)		
long sleeves shirt/trousers	(273)	(99.27)
Glasses	(72)	(26.18)
Hat	(259)	(94.18)
hand grove	(168)	(61.09)
Clean the containers and equipments applied for pesticides by		
Plain water	157	56.48
Detergent	88	31.65
Dish drop	7	2.52
Soap water	22	7.91
Vinegar	3	1.08
Chemical solution	1	0.36
Sickness from consuming plants/animals such as vegetables, field rat in farmland		
Yes	1	0.36
No	156	56.12
Yes but no illness	121	43.52

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Table 4-5 Applied Chemical Pesticides of Informants (Cont.)

Description	Number (n = 278)	Percentage
Sickness symptom from consuming plants/animals such as vegetables, field rat in farmland (n = 1)		
Diarrhea	(1)	(100.00)

Farmer informants applied the following fertilizers and chemical pesticides for maize namely as **Table 4-6** and detailed in **Table 4-7**

Table 4-6 Fertilizer and Chemical Pesticides for maize

Fertilizer		Pesticides	
Formula	**Percentage**	**Name**	**Percentage**
46-0-0	59.74	Alachlor	29.87
21-0-0	20.78	Abamactin	14.29
16-8-8	19.48	Ametryn	11.69
13-13-21	19.48	Paraquat	10.39
25-7-7	16.88	Chlorpyrifos	6.49
15-15-15	15.58	Glyphosate	3.90
4-16-0	2.60	Dimethoate	2.60
16-16-8	3.90	2, 4 D	2.60
21-7-14	3.90		

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Table 4-7 Fertilizer pesticides applied for maize of farmers

Description	Number (n = 278)	Percentage
Type of fertilizer applied for maize*		
Fertilizer Formula 46-0-0	46	59.74
Usage State (n = 46)		
pre plant	(34)	(73.91)
put off pod	(2)	(4.35)
Bedding	(4)	(8.70)
throughout planting	(6)	(13.04)
Usage Ratio (n = 46)		
25 Kg/rai	(8)	(17.39)
50 Kg/rai	(38)	(82.61)
average ratio 45.65 Kg/rai		
Usage Frequency (n = 46)		
1 times	(20)	(43.48)
2 times	(24)	(52.17)
3 times	(2)	(4.35)
average frequency 1.60 times		
Usage Period (n = 46)		
in the morning	(42)	(91.31)
in the afternoon	(3)	(6.52)
All day	(1)	(2.17)
Application Method (n = 46)		
Sow	(46)	(100.00)
Fertilizer Formula 21-0-0	16	20.78
Usage State (n = 16)		
pre plant	(13)	(81.25)
put off pod	(2)	(12.50)
Throughout planting	(1)	(6.25)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Ratio (n = 16)		
50 Kg/rai	(16)	(100.00)
Usage Frequency (n = 16)		
1 times	(4)	(25.00)
2 times	(6)	(37.50)
3 times	(6)	(37.50)
average frequency 2.12 times		
Usage Period (n = 16)		
in the morning	(16)	(100.00)
Application (n = 16)		
Sow	(14)	(87.50)
Inject	(2)	(12.50)
Fertilizer Formula 16-8-8	15	19.48
Usage State (n = 15)		
put off pod	(2)	(13.33)
Blossom	(1)	(6.67)
Age 45 days	(2)	(13.33)
bedding	(10)	(66.67)
Usage Ratio (n = 15)		
17 Kg/rai	(1)	(6.67)
25 Kg/rai	(5)	(33.33)
28 Kg/rai	(1)	(6.67)
50 Kg/rai	(8)	(53.33)
average ratio 38.0 Kg/rai		

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Frequency (n = 15)		
1 times	(7)	(46.67)
2 times	(6)	(40.00)
3 times	(2)	(13.33)
average frequency 1.66 times		
Usage Period (n = 15)		
in the morning	(15)	(100.00)
Application Method (n = 15)		
Sow	(15)	(100.00)
Fertilizer Formula 4-16-0	2	2.60
Usage State (n = 2)		
throughout planting	(1)	(50.00)
Age 15 days	(1)	(50.00)
Usage Ratio (n = 2)		
50 Kg/rai	(2)	(100.00)
Usage Frequency (n = 2)		
2 times	(2)	(100.00)
Usage Period (n = 2)		
in the morning	(1)	(50.00)
All day	(1)	(50.00)
Application Method (n = 2)		
Sow	(2)	(100.00)
Fertilizer Formula 15-15-15	12	15.58
Usage State (n = 12)		
Bedding	(8)	(66.67)
Before non-breeding period	(4)	(33.33)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Ratio (n = 12)		
30 Kg/rai	(3)	(25.00)
50 Kg/rai	(9)	(75.00)
average ratio 45 Kg/rai		
Usage Frequency (n = 12)		
1 times	(8)	(66.67)
2 times	(4)	(33.33)
average frequency 1.33 times		
Usage Period (n = 12)		
in the morning	(10)	(83.34)
in the afternoon	(1)	(8.33)
All day	(1)	(8.33)
Application Method (n = 12)		
Sow	(12)	(100.00)
Fertilizer Formula 13-13-21	15	19.48
Usage State (n = 15)		
before harvest 20 days	(4)	(26.67)
pre plant	(8)	(53.33)
accelerate growth	(3)	(20.00)
Usage Ratio (n = 15)		
25 Kg/rai	(1)	(6.67)
30 Kg/rai	(1)	(6.67)
50 Kg/rai	(10)	(66.66)
100 Kg/rai	(3)	(20.00)
average ratio 57.0 Kg/rai		

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Frequency (n = 15)		
1 times	(8)	(53.33)
2 times	(7)	(46.67)
average frequency 1.46 times		
Usage Period (n = 15)		
in the morning	(6)	(40.00)
in the afternoon	(4)	(26.67)
in the evening	(3)	(20.00)
All day	(2)	(13.33)
Application (n = 15)		
Sow	(15)	(100.00)
Fertilizer Formula 16-16-8	3	3.90
Usage State (n = 3)		
after planting 20 days	(2)	(66.67)
put off pod	(1)	(33.33)
Usage Ratio (n = 3)		
50 Kg/rai	(3)	(100.00)
Usage Frequency (n = 3)		
1 times	(1)	(33.33)
2 times	(2)	(66.67)
average frequency 1.66 times		
Usage Period (n = 3)		
in the morning	(3)	(100.00)
Application (n = 3)		
Sow	(3)	(100.00)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Fertilizer Formula 21-7-14	3	3.90
Usage State (n = 3)		
accelerate growth	(3)	(100.00)
Usage Ratio (n = 3)		
20 Kg/rai	(1)	(33.33)
30 Kg/rai	(2)	(66.67)
average ratio 26.66 Kg/rai		
Usage Frequency (n = 3)		
2 times	(2)	(66.67)
5 times	(1)	(33.33)
average frequency 3 times		
Usage Period (n = 3)		
Sow	(3)	(100.00)
Application Method (n = 3)		
Sow	(3)	(100.00)
Fertilizer Formula 25-7-7	13	16.88
Usage State (n = 13)		
Non-breeding period	(2)	(15.39)
30 days	(1)	(7.69)
throughout planting	(1)	(7.69)
pre plant	(1)	(7.69)
put off pod	(8)	(61.54)
Usage Ratio (n = 13)		
30 Kg/rai	(3)	(23.08)
50 Kg/rai	(10)	(76.92)
Average ratio 45.38 Kg/rai		

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Frequency (n = 13)		
1 times	(6)	(46.15)
2 times	(4)	(30.77)
3 times	(3)	(23.08)
Average frequency		
Usage Period (n = 13)		
in the morning	(13)	(100.00)
Application (n = 13)		
Sow	(13)	(100.00)
Types of chemicals to protect and eliminate pest of maize*		
Abamactin	11	14.29
Usage State (n = 11)		
Eliminate maggots	(11)	(100.00)
Usage Ratio (n = 11)		
500 cc. per water 200 liter	(11)	(100.00)
Usage Frequency (n = 11)		
1 times	(3)	(27.28)
2 times	(4)	(36.36)
3 times	(4)	(36.36)
average frequency 2.09 times		
Usage Period (n = 11)		
in the morning	(9)	(81.82)
in the evening	(2)	(18.18)
Application Method (n = 11)		
Inject	(11)	(100.00)
Paraquat	8	10.39
Usage State (n = 8)		
Eliminate grasses	(8)	(100.00)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 278)	Percentage
Usage Ratio (n = 8)		
200 cc. per water 200 liter	(8)	(100.00)
Usage Frequency (n = 8)		
1 times	(3)	(37.50)
2 times	(3)	(37.50)
3 times	(1)	(12.50)
4 times	(1)	(12.50)
average frequency 2 times		
Usage Period (n = 8)		
in the morning	(8)	(100.00)
Application Method (n = 8)		
Inject	(8)	(100.00)
Gyphosate	3	3.90
Usage State (n = 3)		
Eliminate grasses	(3)	(100.00)
Usage Ratio (n = 3)		
A half of Kg. per water 200 liter	(3)	(100.00)
Usage Frequency (n = 3)		
2 times	(2)	(66.67)
4 times	(1)	(33.33)
average frequency 2.66 times		
Usage Period (n = 3)		
in the morning	(3)	(100.00)
Application Method (n = 3)		
Inject	(3)	(100.00)
Atrazine	14	18.18
Usage State (n = 14)		
Eliminate grasses	(14)	(100.00)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 77)	Percentage
Usage Ratio (n = 14)		
1 liter per water 200 liter	(14)	(100.00)
Usage Frequency (n = 14)		
1 times	(9)	(64.29)
2 times	(5)	(35.71)
average frequency 1.35times		
Usage Period (n = 14)		
in the morning	(13)	(92.86)
in the evening	(1)	(7.14)
Application (n = 14)		
Inject	(14)	(100.00)
Ametryn	9	11.69
Usage State (n = 9)		
Control grasses	(9)	(100.00)
Usage Ratio (n = 9)		
1 liter per water 200 liter	(9)	(100.00)
Usage Frequency (n = 9)		
1 times	(3)	(33.33)
2 times	(6)	(66.67)
average frequency 1.66 times		
Usage Period (n = 9)		
in the morning	(9)	(100.00)
Application (n = 9)		
Inject	(9)	(100.00)
Alachlor	23	29.87
Usage State (n = 23)		
Control grasses	(23)	(100.00)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 77)	Percentage
Usage Ratio (n = 23)		
2 liter per water 200 liter	(23)	(100.00)
Usage Frequency (n = 23)		
1 times	(12)	(52.17)
2 times	(6)	(26.09)
3 times	(5)	(21.74)
average frequency 1.69 times		
Usage Period (n = 23)		
in the morning	(22)	(95.65)
in the evening	(1)	(4.35)
Application Method (n = 23)		
Inject	(23)	(100.00)
2 4 D	2	2.60
Usage State (n = 2)		
Eliminate climbing plants	(2)	(100.00)
Usage Ratio (n = 2)		
20 cc. per water 200 liter	(2)	(100.00)
Usage Frequency (n = 2)		
2 times	(2)	(100.00)
Usage Period (n = 2)		
in the morning	(2)	(100.00)
Application Method (n = 2)		
Inject	(2)	(100.00)
Dimethoate	2	2.60
Usage State (n = 2)		
Eliminate grasses	(2)	(100.00)

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Table 4-7 Fertilizer pesticides applied for maize of farmers (Cont.)

Description	Number (n = 77)	Percentage
Usage Ratio (n = 2)		
500 cc. per water 200 liter	(2)	(100.00)
Usage Frequency (n = 2)		
1 times	(2)	(100.00)
Usage Period (n = 2)		
in the morning	(1)	(50.00)
in the evening	(1)	(50.00)
Application (n = 2)		
Inject	(2)	(100.00)
Chlorpyrifos	5	6.49
Usage State (n = 5)		
Eliminate maggots	(5)	(100.00)
Usage Ratio (n = 5)		
1 liter per water 200 liter	(5)	(100.00)
Usage Frequency (n = 5)		
1 times	(3)	(60.00)
2 times	(2)	(40.00)
average frequency 1.40 times		
Usage Period (n = 5)		
in the morning	(5)	(100.00)
Application Method (n = 5)		
Inject	(5)	(100.00)

Remark *Can answer more than 1 topic

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Farmer informants applied the following fertilizers and chemical pesticides for sugar cane namely as **Table 4-8** and detailed in **Table 4-9**

Table 4-8 Fertilizer and Chemical Pesticides for sugar cane

Fertilizer		**Pesticides**	
Formula	**Percentage**	**Name**	**Percentage**
21-0-0	72.67	Ametryn	64.67
46-0-0	18.67	Atrazine	62.00
15-15-15	9.33	Gramoxzone	27.33
16-8-8	8.00	2, 4 D	24.67
16-20-20	6.00	Paraquat	14.00
16-20-0	3.3	Gyphosate	4.67
26-0-0	2.67		
20-0-0	1.33		

Table 4-9 Fertilizer pesticides applied for sugar cane of farmers

Description	**Number (n = 150)**	**Percentage**
Type of fertilizer applied for sugar cane*		
Fertilizer Formula 21-0-0	109	72.67
Usage State (n = 109)		
pre plant	(37)	(33.95)
Bedding	(8)	(7.34)
back fill up	(18)	(16.51)
Irrigation	(46)	(42.20)
Usage Ratio (n = 109)		
20 Kg/rai	(1)	(0.92)
25 Kg/rai	(1)	(0.92)
50 Kg/rai	(82)	(75.23)

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
70 Kg/rai	(1)	(0.92)
75 Kg/rai	(9)	(8.26)
100 Kg/rai	(13)	(11.92)
150 Kg/rai	(2)	(1.83)
average ratio 59.54 Kg/rai		
Usage Frequency (n = 109)		
1 times	(47)	(43.12)
2 times	(58)	(53.21)
3 times	(4)	(3.67)
average frequency 1.60 times		
Usage Period (n = 109)		
in the morning	(109)	(100.00)
Application Method (n = 109)		
Sow	(109)	(100.00)
Fertilizer Formula 15-15-15	14	9.33
Usage State (n = 14)		
Bedding	(12)	(85.72)
Accelerate growth	(1)	(7.14)
Irrigation	(1)	(7.14)
Usage Ratio (n = 14)		
15 Kg/rai	(1)	(7.14)
25 Kg/rai	(2)	(14.29)
30 Kg/rai	(1)	(7.14)
50 Kg/rai	(9)	(64.29)
75 Kg/rai	(1)	(7.14)
average ratio 44.28 Kg/rai		

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Frequency (n = 14)		
1 times	(1)	(7.14)
2 times	(13)	(92.86)
average frequency 1.92 times		
Usage Period (n = 14)		
in the morning	(14)	(100.00)
Application Method (n = 14)		
Sow	(14)	(100.00)
Fertilizer Formula 16-8-8	(12	(8.00
Usage State (n = 12)		
Bedding	(7)	(58.33)
Accelerate growth	(2)	(16.67)
back fill up	(2)	(16.67)
Irrigation	(1)	(8.33)
Usage Ratio (n = 12)		
25 Kg/rai	(1)	(8.33)
50 Kg/rai	(11)	(91.67)
average ratio 47.91 Kg/rai		
Usage Frequency (n = 12)		
1 times	(7)	(58.33)
2 times	(5)	(41.67)
average frequency 1.41 times		
Usage Period (n = 12)		
in the morning	(12)	(100.00)
Application Method (n = 12)		
Sow	(12)	(100.00)

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Fertilizer Formula 26-0-0	4	2.67
Usage State (n = 4)		
Irrigation	(3)	(75.00)
bedding	(1)	(25.00)
Usage Ratio (n = 4)		
25 Kg/rai	(1)	(25.00)
50 Kg/rai	(2)	(50.00)
75 Kg/rai	(1)	(25.00)
average ratio 50 Kg/rai		
Usage Frequency (n = 4)		
1 times	(2)	(50.00)
2 times	(2)	(50.00)
average frequency 1.50 times		
Usage Period (n = 4)		
in the morning	(4)	(100.00)
Application Method (n = 4)		
Sow	(4)	(100.00)
Fertilizer Formula 46-0-0	28	18.67
Usage State (n = 28)		
Pre mergence	(8)	(28.57)
Bedding	(12)	(42.86)
Irrigation	(8)	(28.57)
Usage Ratio (n = 28)		
25 Kg/rai	(4)	(14.29)
30 Kg/rai	(1)	(3.57)
50 Kg/rai	(20)	(71.43)
100 Kg/rai	(3)	(10.71)
average ratio 51.07 Kg/rai		

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Frequency (n = 28)		
1 times	(11)	(39.29)
2 times	(17)	(60.71)
average frequency 1.60 times		
Usage Period (n = 28)		
in the morning	(28)	(100.00)
Application Method (n = 28)		
Sow	(28)	(100.00)
Fertilizer Formula 16-20-20	9	6.00
Usage State (n = 9)		
Bedding	(8)	(88.89)
pre mergence	(1)	(11.11)
Usage Ratio (n = 9)		
20 Kg/rai	(1)	(11.11)
25 Kg/rai	(1)	(11.11)
30 Kg/rai	(1)	(11.11)
50 Kg/rai	(5)	(55.56)
75 Kg/rai	(1)	(11.11)
average ratio 44.44 Kg/rai		
Usage Frequency (n = 9)		
1 times	(4)	(44.44)
2 times	(5)	(55.56)
average frequency 1.55 times		
Usage Period (n = 9)		
in the morning	(9)	(100.00)
Application Method (n = 9)		
Sow	(9)	(100.00)

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Fertilizer Formula 20-0-0	2	1.33
Usage State (n = 2)		
pre mergence	(2)	(100.00)
Usage Ratio (n = 2)		
50 Kg/rai	(1)	(50.00)
100 Kg/rai	(1)	(50.00)
average ratio 45.65 Kg/rai		
Usage Frequency (n = 2)		
1 times	(1)	(50.00)
2 times	(1)	(50.00)
average frequency 1.50 times		
Usage Period (n = 2)		
in the morning	(2)	(100.00)
Application (n = 2)		
Sow	(2)	(100.00)
Fertilizer Formula 16-20-0	5	3.33
Usage State (n = 5)		
Bedding	(4)	(80.00)
Irrigation	(1)	(20.00)
Usage Ratio (n = 5)		
25 Kg/rai	(1)	(20.00)
50 Kg/rai	(4)	(80.00)
average ratio 45.65 Kg/rai		
Usage Frequency (n = 5)		
1 times	(2)	(40.00)
2 times	(2)	(40.00)
3 times	(1)	(20.00)
average frequency 1.80 times		

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Period (n = 5)		
in the morning	(5)	(100.00)
Application Method (n = 5)		
Sow	(5)	(100.00)
Types of chemicals to protect and eliminate pest of sugar cane*		
Paraquat	21	14.00
Usage State (n = 21)		
Eliminate grasses	(21)	(100.00)
Usage Ratio (n = 21)		
A half of liter per water 200 liter	(21)	(100.00)
Usage Frequency (n = 21)		
1 times	(14)	(66.67)
2 times	(7)	(33.33)
average frequency 1.33 times		
Usage Period (n = 21)		
in the morning	(21)	(100.00)
Application Method (n = 21)		
Inject	(21)	(100.00)
Gyphosate	7	4.67
Usage State (n = 7)		
Eliminate grasses	(7)	(100.00)
Usage Ratio (n = 7)		
1 liter per water 200 liter	(7)	(100.00)
Usage Frequency (n = 7)		
1 times	(4)	(57.14)
2 times	(3)	(42.86)
average frequency 1.42 times		

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Period (n = 7)		
in the morning	(7)	(100.00)
Application Method (n = 7)		
Inject	(7)	(100.00)
Gramoxzone	41	27.33
Usage State (n = 41)		
Eliminate grasses	(41)	(100.00)
Usage Ratio (n = 41)		
1 liter per water 200 liter	(41)	(100.00)
Usage Frequency (n = 41)		
1 times	(15)	(36.59)
2 times	(19)	(46.34)
3 times	(6)	(14.63)
4 times	(1)	(2.44)
average frequency 1.82 times		
Usage Period (n = 41)		
in the morning	(41)	(100.00)
Application Method (n = 41)		
Inject	(41)	(100.00)
Atrazine	93	62.00
Usage State (n = 93)		
Eliminate grasses	(93)	(100.00)
Usage Ratio (n = 93)		
1 Kg. per water 200 liter	(93)	(100.00)

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Frequency (n = 93)		
1 times	(27)	(29.03)
2 times	(62)	(66.67)
3 times	(4)	(4.30)
average frequency 1.75 times		
Usage Period (n = 93)		
in the morning	(92)	(98.92)
in the evening	(1)	(1.08)
Application Method (n = 93)		
Inject	(93)	(100.00)
Ametryn	97	64.67
Usage State (n = 97)		
Control grasses	(97)	(100.00)
Usage Ratio (n = 97)		
1 Kg. per water 200 liter	(97)	100.00)
Usage Frequency (n = 97)		
1 times	(44)	(45.36)
2 times	(50)	(51.55)
3 times	(3)	(3.09)
average frequency 1.57 times		
Usage Period (n = 97)		
in the morning	(96)	(98.97)
in the evening	(1)	(1.03)
Application Method (n = 97)		
Inject	(97)	(100.00)
2 4 D	37	24.67
Usage State (n = 37)		
Eliminate climbing plants	(37)	(100.00)

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Table 4-9 Fertilizer pesticides applied for sugar cane of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Ratio (n = 37)		
1 liter per water 200 liter	(37)	(100.00)
Usage Frequency (n = 37)		
1 times	(9)	(24.33)
2 times	(27)	(72.97)
3 times	(1)	(2.70)
average frequency 1.78 times		
Usage Period (n = 37)		
in the morning	(35)	(94.60)
in the afternoon	(1)	(2.70)
in the evening	(1)	(2.70)
Application Method (n = 37)		
Inject	(37)	(100.00)

Remark *Can answer more than 1 topic

Farmer informants applied the following fertilizers and chemical pesticides for cassava namely as **Table 4-10** and detailed in **Table 4-11**

Table 4-10 Fertilizer and Chemical Pesticides for cassava

Fertilizer		Pesticides	
Formula	**Percentage**	**Name**	**Percentage**
15-15-15	56.86	Gyphosate	56.86
46-0-0	52.94	2, 4 D	43.14
16-8-8	7.84	Gramoxzone	27.45
15-16-0	5.88	Paraquat	25.49
30-0-0	3.92	Alachlor	19.61
8-24-24	1.96	Atrazine	13.73
15-5-20	1.96	Ametryne	11.76

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Table 4-11 Fertilizer pesticides applied for cassava of farmers

Description	Number (n = 150)	Percentage
Type of fertilizer applied for cassava*		
Fertilizer Formula 15-15-15	29	56.86
Usage State (n = 29)		
bedding	(25)	(86.21)
pre mergence	(4)	(13.79)
Usage Ratio (n = 29)		
25 Kg/rai	(7)	(24.14)
30 Kg/rai	(1)	(3.45)
50 Kg/rai	(21)	(72.41)
average ratio 43.27 Kg/rai		
Usage Frequency (n = 29)		
1 times	(4)	(13.79)
2 times	(25)	(86.21)
average frequency 1.86 times		
Usage Period (n = 29)		
in the morning	(29)	(100.00)
Application Method (n = 29)		
Sow	(29)	(100.00)
Fertilizer Formula 16-8-8	4	7.84
Usage State (n = 4)		
Accelerate growth	(4)	(100.00)
Usage Ratio (n = 4)		
25 Kg/rai	(4)	(100.00)
Usage Frequency (n = 4)		
1 times	(4)	(100.00)
Usage Period (n = 4)		
in the morning	(4)	(100.00)

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Application Method (n = 4)		
Sow	(4)	(100.00)
Fertilizer Formula 46-0-0	27	52.94
Usage State (n = 27)		
throughout planting	(7)	(25.93)
45 days	(2)	(7.41)
Bedding	(18)	(66.66)
Usage Ratio (n = 27)		
20 Kg/rai	(1)	(3.71)
25 Kg/rai	(12)	(44.44)
50 Kg/rai	(12)	(44.44)
75 Kg/rai	(2)	(7.41)
average ratio 39.62 Kg/rai		
Usage Frequency (n = 27)		
1 times	(1)	(3.71)
2 times	(25)	(92.58)
3 times	(1)	(3.71)
average frequency 2 times		
Usage Period (n = 27)		
in the morning	(27)	(100.00)
Application Method (n = 27)		
sow	(27)	(100.00)
Fertilizer Formula 30-0-0	2	3.92
Usage State (n = 2)		
pre mergence	(2)	(100.00)
Usage Ratio (n = 2)		
25 Kg/rai	(2)	(100.00)

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Frequency (n = 2)		
1 times	(1)	(50.00)
4 times	(1)	(50.00)
average frequency 2.50 times		
Usage Period (n = 2)		
in the morning	(2)	(100.00)
Application (n = 2)		
sow	(2)	(100.00)
Fertilizer Formula 15-16-0	3	5.88
Usage State (n = 3)		
accelerate tuber growth	(3)	(100.00)
Usage Ratio (n = 3)		
25 Kg/rai	(3)	(100.00)
Usage Frequency (n = 3)		
1 times	(1)	(33.33)
2 times	(2)	(66.67)
average frequency 1.66 times		
Usage Period (n = 3)		
in the morning	(2)	(66.67)
All day	(1)	(33.33)
Application Method (n = 3)		
sow	(3)	(100.00)
Fertilizer Formula 8-24-24	1	1.96
Usage State (n = 1)		
pre mergence	(1)	(100.00)
Usage Ratio (n = 1)		
50 Kg/rai	(1)	(100.00)

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Frequency (n = 1)		
1 times	(1)	(100.00)
Usage Period (n = 1)		
in the morning	(1)	(100.00)
Application Method (n = 1)		
Sow	(1)	(100.00)
Fertilizer Formula 15-5-20	1	1.96
Usage State (n = 1)		
Bedding	(1)	(100.00)
Usage Ratio (n = 1)		
50 Kg/rai	(1)	(100.00)
Usage Frequency (n = 1)		
2 times	(1)	(100.00)
Usage Period (n = 1)		
in the morning	(1)	(100.00)
Application (n = 1)		
Sow	(1)	(100.00)
Types of chemicals to protect and eliminate pest of cassava*		
2 4 D	22	43.14
Usage State (n = 22)		
Eliminate climbing plants	(22)	(100.00)
Usage Ratio (n = 22)		
20 cc. per water 200 liter	(22)	(100.00)
Usage Frequency (n = 22)		
1 times	(8)	(36.36)
2 times	(14)	(63.64)
average frequency 1.63 times		

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Period (n = 22)		
in the morning	(22)	(100.00)
Application Method (n = 22)		
Inject	(22)	(100.00)
Ametryn	6	11.76
Usage State (n = 6)		
Control grasses	(6)	(100.00)
Usage Ratio (n = 6)		
1 liter per water 200 liter	(6)	(100.00)
Usage Frequency (n = 6)		
1 times	(2)	(33.33)
2 times	(4)	(66.67)
Average frequency 1.66 times		
Usage Period (n = 6)		
in the morning	(6)	(100.00)
Application (n = 6)		
Inject	(6)	(100.00)
Atrazine	7	13.73
Usage State (n = 7)		
Eliminate grasses	(7)	(100.00)
Usage Ratio (n = 7)		
1 liter per water 200 liter	(7)	(100.00)
Usage Frequency (n = 7)		
1 times	(2)	(28.57)
2 times	(5)	(71.43)
average frequency 1.71 times		

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Period (n = 7)		
in the morning	(7)	(100.00)
Application Method (n = 7)		
inject	(7)	(100.00)
Gyphosate	29	56.86
Usage State (n = 29)		
Eliminate grasses	(29)	(100.00)
Usage Ratio (n = 29)		
2 liter per water 200 liter	(29)	(100.00)
Usage Frequency (n = 29)		
1 times	(14)	(48.28)
2 times	(14)	(48.28)
4 times	(1)	(3.44)
average frequency 1.58 times		
Usage Period (n = 29)		
in the morning	(29)	(100.00)
Application Method (n = 29)		
Inject	(29)	(100.00)
Gramoxzone	13	25.49
Usage State (n = 13)		
Eliminate grasses	(13)	(100.00)
Usage Ratio (n = 13)		
1 liter per water 200 liter	(13)	(100.00)
Usage Frequency (n = 13)		
1 times	(3)	(23.08)
2 times	(10)	(76.92)
average frequency 1.76 times		

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Usage Period (n = 13)		
in the morning	(12)	(92.31)
All day	(1)	(7.69)
Application Method (n = 13)		
inject	(13)	(100.00)
Paraquat	13	25.49
Usage State (n = 13)		
Eliminate grasses	(13)	(100.00)
Usage Ratio (n = 13)		
1 liter per water 200 liter	(13)	(100.00)
Usage Frequency (n = 13)		
1 times	(10)	(76.92)
2 times	(3)	(23.08)
average frequency 1.23 times		
Usage Period (n = 13)		
in the morning	(13)	(100.00)
Application Method (n = 13)		
Inject	(13)	(100.00)
Khamoxzone	1	1.96
Usage State (n = 1)		
Control grasses	(1)	(100.00)
Usage Ratio (n = 1)		
20 cc. per water 200 liter	(1)	(100.00)
Usage Frequency (n = 1)		
2 times	(1)	(100.00)
Usage Period (n = 1)		
in the morning	(1)	(100.00)

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Table 4-11 Fertilizer pesticides applied for cassava of farmers (Cont.)

Description	Number (n = 150)	Percentage
Application Method (n = 1)		
Inject	(1)	(100.00)
Alachlor	10	19.61
Usage State (n = 10)		
Control grasses	(10)	(100.00)
Usage Ratio (n = 10)		
1 liter per water 200 liter	(10)	(100.00)
Usage Frequency (n = 10)		
1 times	(5)	(50.00)
2 times	(3)	(30.00)
3 times	(1)	(10.00)
4 times	(1)	(10.00)
average frequency 1.80 times		
Usage Period (n = 10)		
in the morning	(10)	(100.00)
Application Method (n = 10)		
Inject	(10)	(100.00)

4.2.5 Practices on Organic Fertilizers of Farmers

Almost of informants know the organic fertilizers (63.23%) from their neighbor/ associated club member most (33.52%) next is from radio television (23.70%) and government officers (18.50%) such as Chief of District Agricultural Extension Office, Director of Provincial Agricultural Office, Department of Agriculture Extension in Chiengrai, Professors of Agricultural University and Land Development Department Officers. Most farmers used to gain knowledge on organic fertilizers (74.57%) from the important sources such as their neighbor/ associated club member, government officers, radio television and magazines/television. Most informants promptly applied the organic fertilizers for their planting (70.52%)

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because they are satisfied on using of chemicals for agriculture, afraid of exporting impact and aware of its slow outcome as shown in Table 4-12

Table 4-12 Practices on Organic Fertilizers of Farmers

Description	Number (n = 150)	Percentage
Know organic fertilizers		
Yes	173	62.23
No	105	37.77
Advisors of organic fertilizers (n = 173)		
Neighbor/ associated club member	(58)	(33.52)
Government officers	(32)	(18.50)
Magazines/Newspaper	(23)	(13.29)
Radio Television	(41)	(23.70)
Educational institute	(2)	(1.16)
Trader/Distributor Agent	(17)	(9.83)
Government officers who provided knowledge on organic fertilizers (n = 32)		
Director of Province Agricultural Extension Office	(2)	(6.25)
Department of Agriculture Extension in Chiengrai	(1)	(3.12)
University of Agriculture	(1)	(3.12)
Chief of District Agricultural Extension Office	(26)	(81.26)
Land Development Department	(2)	(6.25)
Gained knowledge on organic fertilizers (n = 173)		
Familiar	(129)	(74.57)
Unfamiliar	44)	(25.43)

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Table 4-12 Practices on Organic Fertilizers of Farmers (Cont.)

Description	Number (n = 150)	Percentage
Sources of knowledge on organic fertilizers (n = 129)		
Neighbor/ associated club member	(43)	(33.33)
Government officers	(31)	(24.03)
Magazines/Newspaper	(21)	(16.28)
Radio Television	(25)	(19.38)
Educational institute	(2)	(1.55)
Trader/Distributor Agent	(7)	(5.4)
Government officers who provided knowledge on organic fertilizers (n = 31)		
Director of Province Agricultural Extension Office	(1)	(3.22)
Department of Agriculture Extension in Chiengrai	(1)	(3.22)
Chief of District Agricultural Extension Office	(26)	(83.88)
Land Development Department	(3)	(9.68)
Application of organic fertilizers in occupation		
Yes	(51)	(29.48)
No	(122)	(70.52)
Causes to apply the organic fertilizers in occupation (n = 51)		
Gain favorable outcomes	23)	(45.10)
Soil improvement	11)	(21.57)
Save cost	(13)	(25.49)
Save cost	(1)	(1.96)
Trial	(3)	(5.88)

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Table 4-12 Practices on Organic Fertilizers of Farmers (Cont.)

Description	Number (n = 150)	Percentage
Causes not to apply the organic fertilizers in occupation (n = 122)		
afraid of exporting impact	(17)	(13.93)
difficult to buy such chemicals	(5)	(4.10)
no knowledge	(2)	(1.64)
Satisfied on its application	(55)	(45.08)
expensive	(5)	(4.10)
not rely on its production	(8)	(6.56)
unsatisfied with outcomes	(3)	(2.46)
difficult to practice	(9)	(7.38)
low outcome	(16)	(13.11)
Increase cost	(2)	(1.64)

4.3 Knowledge of Chemical Pesticides Application

Almost of informants have knowledge of chemical pesticides application more (97.48%) and the rest gain average knowledge. (2.52%) as shown in Table 4-13

Table 4-13 Knowledge of Chemical Pesticides Application of Informants

Description	Number (n = 150)	Percentage
Knowledge of Chemical Pesticides Application		
Average	7	2.52
High	271	97.48

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4.4 Knowledge of Chemical Pesticides Danger

Almost of informants have average knowledge of chemical pesticides danger (98.20%) and the rest gain knowledge more. (1.80%) as shown in Table 4-14

Table 4-14 Knowledge of Chemical Pesticides Danger of Informants

Description	Number (n = 278)	Percentage
Knowledge of Chemical Pesticides Danger		
Average	273	98.20
High	5	1.80

4.5 Behavior in applying Chemical Pesticides

Almost of informants have average appropriate behavior (1.08%) and the rest have more appropriate behavior in applying chemical pesticides (98.92%) as shown in Table 4-15

Table 4-15 Behavior in applying Chemical Pesticides of Informants

Description	Number (n = 278)	Percentage
Behavior in applying Chemical Pesticides of Informants		
Average appropriate behavior	275	98.92
More appropriate behavior	3	1.08

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4.6 Problems in applying Chemical Pesticides of Informants

Almost of informants have problems or recommendation in applying chemical pesticides (84.17%) such as expensive chemical fertilizers, related organization should provide additional knowledge on chemicals to farmers more, government should promote more on the effective microorganism fertilizers etc.

For burning the stubbles after cultivation found that farmers do burning more than those don't at 52.88% and 47.12%,respectively. Most farmers reasoned that it is convenience for the next planting. Secondly, the stubbles were burnt by the capitalists and lastly is to save time in eliminating of stubbles. The following descriptions are presented in Table 4-16.

Table 4-16 Problems in applying Chemical Pesticides of Informants

Description	**Number (n = 278)**	**Percentage**
Problems or recommendations in applying chemical pesticides		
Yes	44	15.83
No	234	84.17
Details of problems or recommendations in applying chemical pesticides (n = 44)		
Prohibit chemicals should be totally eliminated.	(5)	(11.36)
Government should promote more on the effective microorganism fertilizers.	(3)	(6.82)
Chemical fertilizers are expensive.	(11)	(25.00)
Related organization should provide more additional knowledge on chemicals to farmers.	(12)	(27.27)

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Table 4-16 Problems in applying Chemical Pesticides of Informants (Cont.)

Description	Number (n = 278)	Percentage
Government should control the production and its distribution.	(1)	(2.28)
Those chemicals are less effective.	(12)	(27.27)
Burning the stubbles after cultivation		
Yes	147	52.88
No	131	47.12
Causes to burn the stubbles after cultivation (n = 147)		
convenience for the next planting	(133)	(90.48)
save time in eliminating of stubbles	(5)	(3.40)
to eliminate grasses	(1)	(0.68)
the stubbles were burnt by the capitalists	(8)	(5.44)
Causes to burn the stubbles after cultivation (n = 131)		
to make fertilizers	(69)	(52.67)
to make pet food	(2)	(1.53)
burning make top soil damage	(26)	(19.85)
to cover top soil	(15)	(11.45)
release for natural degradation	(17)	(12.98)
to be fuel	(1)	(0.76)
to sell	(1)	(0.76)

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4.7 Research Proof of Hypothesis

4.7.1 Proof of Personal Hypothesis

1) Female informants have different behavior in applying chemical pesticides from male Informants.

Based on the comparative of behavior-use of pesticides and genders, different genders don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of gender hypothesis is rejected as presented in Table 4-17.

Table 4-17 Comparative of Behavior-Use of Pesticides and Genders of Informants

Description	Gender		ANOVA	Sig.
	Male (n = 174)	Female (n = 104)		
Behavior-Use of Pesticides	2.99	2.98	1.10	0.29

Remark *No have significant different in statistics at 0.05

2) Informants having different ages have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and ages, different ages don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of age hypothesis is rejected as presented in Table 4-18.

Table 4-18 Comparative of Behavior-Use of Pesticides and Ages of Informants

Description	Age					ANOVA	Sig.
	Age < 31 year	Age 31 – 40 year (n = 75)	Age 41 – 50 year (n = 97)	Age 51 – 60 year (n = 54)	Age > 60 year (n = 36)		
Behavior-Use of Pesticides	3.00	3.00	2.97	2.98	3.00	0.63	0.63

Remark *No have significant different in statistics at 0.05

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3) Informants having different educational levels have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and educational levels, different educational levels don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of educational levels hypothesis is rejected as presented in Table 4-19.

Table 4-19 Comparative of Behavior-Use of Pesticides and Educational Levels of Informants

Description	**Education Level**								**ANOVA**	**Sig.**
	Not learn (n = 4)	**Junior Primary School (n = 101)**	**Senior Primary School (n = 133)**	**Junior Secondary School (n = 15)**	**Senior Secondary School (n = 20)**	**Junior Certificate (n = 3)**	**Senior Certificate (n = 1)**	**Bachelor Degree (n = 1)**		
Behavior-Use of Pesticides	3.00	2.99	2.99	2.93	3.00	3.00	3.00	3.00	0.68	0.68

Remark *No have significant different in statistics at 0.05

4) Informants having different annual incomes have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and annual incomes, different annual incomes don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of annual income hypothesis is rejected as presented in Table 4-20.

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Table 4-20 Comparative of Behavior-Use of Pesticides and Annual Incomes of Informants

Description	Annual Income					ANOVA	Sig.
	> 50,000 Baht (n = 94)	50,001 - 100,000 Baht	100,001 - 200,000 Baht	200,001 - 300,000 Baht	300,001 Baht up (n = 20)		
Behavior-Use of Pesticides	2.96	3.00	3.00	3.00	3.00	1.48	0.20

Remark *No have significant different in statistics at 0.05

5) Informants having different size of farmland have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and size of farmland, different size of farmland don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of size of farmland hypothesis is rejected as presented in Table 4-21.

Table 4-21 Comparative of Behavior-Use of Pesticides and Size of Farmland of Informants

Description	Size of Farmland					ANOVA	Sig.
	> 11 rai (n = 128)	11 – 20 rai (n = 79)	21 – 30 rai (n = 25)	31 – 40 rai (n = 18)	< 40 rai (n = 28)		
Behavior-Use of Pesticides	2.98	3.00	2.96	3.00	3.00	0.90	0.46

Remark *No have significant different in statistics at 0.05

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6) Informants having different characteristics of land tenure have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and land tenure, different characteristics of land tenure don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of characteristics of land tenure hypothesis is rejected as presented in Table 4-22.

Table 4-22 Comparative of Behavior-Use of Pesticides and Characteristics of Land Tenure of Informants

Description	Characteristics of Land Tenure			ANOVA	Sig.
	Landlord (n = 191)	Land Tenement (n = 50)	Landlord and Land Tenement (n = 37)		
Behavior-Use of Pesticides	2.98	3.00	3.00	0.68	0.50

Remark *No have significant different in statistics at 0.05

4.7.2 Proof of General Factor Hypothesis

1) Informants receiving different information have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and information received, different information received don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of information received hypothesis is rejected as presented in Table 4-23.

Table 4-23 Comparative of Behavior-Use of Pesticides and Information received of Informants

Description	Information received			ANOVA	Sig.
	Low (n = 232)	Medium (n = 40)	High (n = 1)		
Behavior-Use of Pesticides	2.98	3.00	3.00	0.26	0.77

Remark *No have significant different in statistics at 0.05

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2) Informants having different period of occupation have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and period of occupation, different period of occupation don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of period of occupation hypothesis is rejected as presented in Table 4-24.

Table 4-24 Comparative of Behavior-Use of Pesticides and Period of Occupation of Informants

Description	**Period of Occupation**				**ANOVA**	**Sig.**
	> 1 year (n = 129)	**11 – 20 years**	**21 – 30 years**	**< 30 years (n = 13)**		
Behavior-Use of Pesticides	2.98	3.00	2.97	3.00	0.60	0.61

Remark *No have significant different in statistics at 0.05

3) Informants having different number of year-use of pesticides have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and number of year-use of pesticides, different number of year-use of pesticides don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of number of year-use of pesticides hypothesis is rejected as presented in Table 4-25.

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Table 4-25 Comparative of Behavior-Use of Pesticides and Number of Year-Use of Pesticides of Informants

Description	Number of Year-Use of Pesticides				ANOVA	Sig.
	> 11 years (n = 155)	11 – 20 years	21 – 30 years	< 30 years (n = 9)		
Behavior-Use of Pesticides	2.98	3.00	2.97	3.00	0.57	0.63

Remark *No have significant different in statistics at 0.05

4) Informants having different experience on pesticides dangers have different behavior in applying chemical pesticides.

4.1) Informants having different experience in taking danger or accidents of pesticides have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and experience in taking danger or accidents of pesticides, different experience in taking danger or accidents of pesticides don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of experience in taking danger or accidents hypothesis is rejected as presented in Table 4-26.

Table 4-26 Comparative of Behavior-Use of Pesticides and Experience in taking Danger or Accidents of Pesticides of Informants

Description	Experience in taking Danger or Accidents of Pesticides		ANOVA	Sig.
	Yes (n = 41)	No (n = 237)		
Behavior-Use of Pesticides	2.97	2.99	0.83	0.36

Remark *No have significant different in statistics at 0.05

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4.2) Informants having different experience related to pesticides danger have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and experience related to pesticides danger, different experience related to pesticides danger take effects to the behavior-use of pesticides. Therefore, the determined research proof of experience related to pesticides danger hypothesis is accepted as presented in Table 4-27.

Table 4-27 Comparative of Behavior-Use of Pesticides and Experience related to Pesticides Danger of Informants

Description	Experience related to Pesticides Danger		ANOVA	Sig.
	Yes (n = 57)	No (n = 221)		
Behavior-Use of Pesticides	2.96	2.99	3.99	0.04*

Remark *Has significant different in statistics at 0.05

5) Informants having different knowledge of chemical pesticides application have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and knowledge of chemical pesticides application, different knowledge of chemical pesticides application take effects to the behavior-use of pesticides. Therefore, the determined research proof of knowledge of pesticides application hypothesis is accepted as presented in Table 4-28.

Table 4-28 Comparative of Behavior-Use of Pesticides and Knowledge of Chemical Pesticides Application of Informants

Description	Knowledge of Pesticides Application		ANOVA	Sig.
	Average (n = 7)	High (n = 271)		
Behavior-Use of Pesticides	2.85	2.99	12.16	0.00*

Remark *has significant different in statistics at 0.05

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6) Informants having different knowledge of chemical pesticides danger have different behavior in applying chemical pesticides.

Based on the comparative of behavior-use of pesticides and knowledge of chemical pesticides danger, different knowledge of chemical pesticides application don't take effects to the behavior-use of pesticides. Therefore, the determined research proof of knowledge of pesticides danger hypothesis is rejected as presented in Table 4-29.

Table 4-29 Comparative of Behavior-Use of Pesticides and Knowledge of Chemical Pesticides Danger of Informants

Description	**Knowledge of Pesticides Danger**		**ANOVA**	**Sig.**
	Average (n = 273)	**High (n = 5)**		
Behavior-Use of Pesticides	2.98	3.00	0.05	0.81

Remark *No have significant different in statistics at 0.05

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CHAPTER V
CONCLUSION AND RECOMMENDATION

The research is to reveal the farmers' behavior in applying chemical pesticides in field crops of cassava, sugar cane and maize at Chainat and Suphanburi provinces. The research outcome can be concluded as follows:

1. Research conclude
2. Research discussion
3. Suggestion

5.1 Research conclude

Research objectives aim at studying the farmer behavior in applying chemical pesticides and factors influencing on their behavior for those planting cassava, sugar cane and maize at Chainat and Suphanburi provinces. With 278 sets of questionnaires as data tools, the core database is collected by 10 surveyors for 1 month from December 2006 to February .2007. Raw data is statistically analyzed by SPSS for windows presenting in tabulation and interpreting by description of which the conclusion is following:

5.1.1 General Data of Informants

Most informants are male with 62.59% averagely 46.76 years and graduated in Primary school with 84.17%. They earn their living by field crop with not more than 100,001 Baht/year. Average period for occupation in agriculture is 15.61 years in farmland of 6-20 rai (50.00%) with labor of averagely 6.73 persons. The labor is distributed from household member averagely 2.77 persons and hire averagely 7.89 persons. Application of chemical matter is mostly from non member of household(37.41%) and farmer themselves (35.61%) The farmer averagely run their activities with 1.49 blocks of average land of 22.00 rai of which are their

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landlord(68.70%). Sugar came is planted most (53.96%). Secondly is maize (27.70%) and the last is cassava (18.34%). Their produces are directly delivered to factory or industrial company (62.23%) as they are binding with contract farming or quota from the factory or industrial company.

5.1.2 Stimulating Factor and Environmental Factor

The informant do know GAP only 5.40% which is suggested by friend/neighbor/member of technical club (53.34%). Most concerns plantation (80.00%), from information (84.98%), government officer mostly (58.33%). Regarding application of GAP, 60% of farmer learn to apply GAP with their activities. Moreover, the farmer is used to gain information about chemical matter and pesticides(98.20%). Level of getting knowledge is mostly rather low (84.98%), fair (14.65%) and high(0.37%) respectively. Only 29.14% of farmer are trained for chemical matters and pesticides in terms of 1) Restricted /Chemical Matter (49.38) 2) Effective Micro Organism(E.M.)/Organic Fertilizer (49.38%) 3) Residues(7.41%) 4) Plantation for Export (1.23%) and 5) Crop Rotation/Multiple Crop(1.23%)

The place where the farmer purchase chemical pesticides are shop (87.77%) with average period used 13.97 years. Never get danger or accident from application (85.25%) and ill (79.50%). The farmers well learn danger of chemical matter or pesticides (98.20%). So the precaution is to self prevention by using personal protective equipment prior to mixing and spraying (98.92%) 1) long sleeves/trousers(99.27%) 2) glasses(26.18%) 3) hat(94.18%) and gloves(61.09%). After using, they always clean particles and tools for chemical pesticides with plain water (56.48%), with detergent(31.65%) and soap water(7.91%). Specifically, the chemical substances and pesticides are tabulated in Table 5-1.

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Table 5-1 Conclusion of Chemical Pesticides of the Farmer at Chainat and Suphanburi Provinces

Type of Crop	Kind of Chemical Matters and Pesticides			
	Fertilizer		Pesticides	
	Formula	Percentage	Name	Percentage
Maize	46-0-0	59.74	Alachlor	29.87
	21-0-0	20.78	Abamactin	14.29
	16-8-8	19.48	Ametryn	11.69
	13-13-21	19.48	Paraquat	10.39
	25-7-7	16.88	Chlorpyrifos	6.49
	15-15-15	15.58	Glyphosate	3.90
	4-16-0	2.60	Dimethoate	2.60
	16-16-8	3.90	2, 4 D	2.60
	21-7-14	3.90		
Sugar Cane	21-0-0	72.67	Ametryn	64.67
	46-0-0	18.67	Atrazine	62.00
	15-15-15	9.33	Gramoxzone	27.33
	16-8-8	8.00	2, 4 D	24.67
	16-20-20	6.00	Paraquat	14.00
	16-20-0	3.3	Gyphosate	4.67
	26-0-0	2.67		
	20-0-0	1.33		
Cassava	15-15-15	56.86	Gyphosate	56.86
	46-0-0	52.94	2, 4 D	43.14
	16-8-8	7.84	Gramoxzone	27.45
	15-16-0	5.88	Paraquat	25.49
	30-0-0	3.92	Alachlor	19.61
	8-24-24	1.96	Atrazine	13.73
	15-5-20	1.96	Ametryne	11.76

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Most of farmer learn organic farming (63.23%) from neighbor/member club(33.52%) from radio and television(23.70%) and government officer (18.50%). Besides they used to gain knowledge of organic agriculture (74.57%) from neighbor/member/member club or from government officer, radio and television and agriculture magazine/newspapers. Anyway, only 29.48% of farmers apply such knowledge for their occupation for the reason that their produces mostly gain advantage from applying organic farming, economic with land improvement.

5.1.3 Knowledge on use of chemical pesticides, its danger and farmer behavior from informants

Most of farmers (97.48%) learns knowledge of chemical pesticides in high level and medium level with 98.20% of knowledge on hazard of chemical pesticide as well as in good understanding level (98.92%) as detailed in Table 5-2.

Table 5-2 Conclusion of Knowledge Use of Chemical Pesticides and Farmer Behavior of the Informants

Items	Knowledge Level/Accurate Behavior Level					
	Low		Medium		High	
	Amount	%	Amount	%	Amount	%
Knowledge use of chemical pesticides	-	-	7	2.52	271	97.48
Knowledge on hazard of chemical pesticides	-	-	273	98.20	5	1.80
Behavior on use of chemical pesticides	-	-	3	1.08	275	98.92

5.1.4 Problem of Chemical Pesticide from Informants

Most of informants (84.17%) have problem or make comment on chemical pesticides particularly on 1) low efficiency of actual chemical substances 2) increasing concern of related agencies on providing knowledge of chemical substances to farmer and 3) more expensive price of chemical pesticides. And burning farmland after harvest season (52.88%) as considerably, burning is convenient for

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the next cultivation, financial backer do in secret, and saving time for eliminating stubbles left after harvesting.

5.1.5 Research Proof of Hypothesis

Research hypothesis is distributed into 2 parts 1) Proof of personal hypothesis: the farmer with different gender, age, educational level, annual income, size of farmland, and characteristic of land tenure are significantly personal factors causing the differences on use of behavior of chemical pesticides. Therefore, the previous hypothesis detailed in Table 5-3 are declined by the researcher.

Table 5-3 Conclusion of Proof of Hypothesis on Personal Factors with Behavior-Use of Chemical Pesticides

Personal factor	Behavior-Use of Pesticides			
	Significant		Hypothesis	
	Significant	Non-significant	Yes	No
Gender		✓		✓
Age		✓		✓
Educational Level		✓		✓
Annual Income		✓		✓
Size of Farmland		✓		✓
Land tenure		✓		✓

General Factors for Proof of Hypothesis The farmer obtaining information who are different in period of occupation, period use of pesticide, risk experience from pesticide application, knowledge of pesticide application. Those general factors do not affect the behavior - use of chemical pesticides. No matter what information obtaining, period of occupation, period use of chemical pesticides, risk experience from pesticide application or knowledge of pesticide application. The precedent hypothesis is thus rejected by the researcher.

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Regarding the different risk experience of danger from pesticide application, and knowledge of pesticide application have an effect on behavior – use of chemical pesticide. The precedent assumption are accordingly accepted by the researcher as tabulated in Table 5-4.

Table 5-4 Conclusion of General factors Assumption Test with Behavior – Use of Chemical Pesticide

General Factors	Behavior – Use of Chemical Pesticide			
	Significant		Hypothesis	
	Significant	Non-significant	Yes	No
Information Obtaining		✓		✓
Period of Occupation		✓		✓
Period Use of Chemical Pesticide		✓		✓
Risk experience from chemical matters application		✓		✓
Risk experience from pesticide application	✓		✓	
Knowledge of pesticide application	✓		✓	
Knowledge of hazard of chemical substances application		✓		✓

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5.2 Research Discussion

Main issues of the research can be discussed as follows:

Farmers who plant field crops of sugar cane, maize, cassava in Chainat and Suphanburi Provinces are rather good at planting such crop in spite the average period of cultivation of 15.61 years and their rather high age with average of 46.76 years that well proves the accumulated experience of agriculture. The labor for running activities is mostly from hiring that include themselves and their household members. Land farms are almost their own and family with averagely suitable size for cultivation for company or industrial factory which contract farming are committed in advance. Almost of farmers (94.60%) have never experienced GAP (Good Agricultural Practice) at all. Though those who have ever got experience (5.40%), only some apply the experience to their farming. The reason is that they do not profoundly understand the system so the outcome is not effective. The reinforcement and public relation of knowledge training on GAP system are substantially required to be proceeded in order that the farmer could apply for their activities. Almost of farmers (98.20%) obtain the information on chemical pesticides but with low level. Providing more information and knowledge to farmer should be reinforced. The remedy is mainly conducted through local public addressing system because of the closest media to farmer. Eevn though almost obtain the information on chemical pesticides, but only farmer of 29.14% who had ever been trained on chemical pesticides such as residues in plants, restricted matters or chemical pesticides, Effective Micro Organism(E.M.)/Organic Fertilizer, plantation for export, crop rotation/multiple crop etc. Apparently, the incidents reveal that most of farmer have not yet really owned profound knowledge on chemical pesticides. Anyway they can do at their ease such as putting long sleeves and trousers, hat, gloves. In addition, only 26.18% put the glasses, clean the particles and tools for chemical pesticides with plain water causing danger, accident and illness to some farmers due to chemical pesticide application. Though only occur with small group of farmer (20.00%), but the event should not have been occurred.

Farmer of 62.23% experience the organic farming although the public relation is vastly conducted through various medias e.g. radio, television, government

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office, magazine and newspaper. However, the source that the farmer can learn organic farming most is their neighbor and member of technical clubs. Thus knowledge awareness is only restricted in daily life. Public relation or knowledge dissemination should be suitably selected such as through public addressing system etc. Anyway, the government officers e.g. Sub-district Agricultural Officer, District Agricultural Officer etc. remain their responsibilities but increasing frequency of visiting the farmer or arranging for knowledge management with meeting could help reinforcement. Nevertheless, farmer of 70.52% do not apply organic farming to their activities due to their satisfaction with facile preparation of chemical matters. On the contrary, an organic farming has difficulties to prepare with multiple steps and delayed outcome. In addition, fertilizer and organic matter are expensive and rare place to be purchased. That why organic farming is not vastly popular to the farmer.

Almost farmers own knowledge of chemical pesticides with high level. But their awareness of its danger is medium level. Abundantly application of chemical pesticides with high level reveal that the farmer who own high experience on chemical pesticides apply the chemical pesticides by themselves and have chronically developed with accumulated skill of application. Concerning the danger of chemical pesticides in medium level, most of farmers have never get danger or accident or ill resulting from correctly abundant application of chemical pesticides

Proving of research hypothesis that the differences on gender, age, educational level, annual income, size of farmland and land tenure, information obtaining, period of occupation, year period of chemical pesticide application, risk experience of chemical pesticides and knowledge of pesticide danger do not concretely have effect on behavior – use of chemical pesticides. The reason may result from certain instruction label attached to chemical bottle or bag of the chemical pesticides that easily comprehend with facile steps. Mentioned factors do not affect the behavior– use of chemical application.

Regarding the factors affected to behavior- use of chemical pesticides is risk experience of chemical pesticide and knowledge of chemical pesticide. The danger and knowledge of chemical matter directly reveal chemical pesticides behavior that is complied with KAP Principle: Knowledge Attitude and Practice. The principle mention to those who are given the stimulated factors result the varied behavior.

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Through farmers with knowledge, such factors differently result the alternated attitude on use of chemical pesticides. In this research, the result of hypothesis test on the factor of the study reveals that the level of education has no effect on behavior of use of chemical pesticides. The result do no comply to the principle due to less sample size that cannot be proven for such factor.

5.3 Recommendation

Recommendation of research are as following

5.3.1 Related government agencies or private sectors should more contribute understanding and knowledge about GAP(Good Agricultural Practice) and organic farming to the farmer by means of various ways such as public addressing system in the community or village

5.3.2 Related government agencies or private sectors should more enhance GAP(Good Agricultural Practice) and organic farming to the farmer for their activities

5.3.3 Related government agencies or private sectors should adjust or develop the channel format in terms of chemical pesticide by more emphasizing on daily life media such as public addressing system in community or village.

5.3.4 Related government agencies or private sectors should expedite providing the knowledge of chemical pesticide such as correct application of chemical matters and cleaning of particles and tools for pesticides etc.

5.3.5 Related government agencies or private sectors should more enhance understanding and knowledge of pesticide danger

5.3.6 Mixing of spraying chemical matters is found the farmer more intensively mix the chemical matters than specified in the label. As they believe that the undertaking can more eradicate the pest than specifying in the label.

5.3.7 There should have especially restricted measures or content inspection of advertisement in terms of chemical characteristics. Because the outcome is found

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almost farmers choose to undertake the chemical pesticides according to suggestion of neighbor or trading agent of chemical company. Only some who perform following to recommendation of related government agencies. With this point of view, the outcome assumes the negative result from public relation media.

5.3.8 The research reveals that the farmer understanding is found drinking Coke help relieve the body toxic obtaining from chemical pesticide. Scientifically, such behave do not relieve any toxic at all. The researcher suggest that the farmer should have been correctly instructed the proper remedy on this issue.

5.3.9 The error of sampling which is found in this research is 0.01 , therefore it is recommended that further research should keep an error between 0.04-0.05 for better accuracy and accountability of study.

5.3.10 For further study, the researcher suggest that the study should focus on other plants, specifically vegetables as vastly consumed. Improper application of chemical pesticide do cause chemical residues in such vegetables and do harm to human body.

5.3.11 This study focuses on Chainat and Suphanburi Provinces which are located in Thachin River Basin further study should be extended other provinces of Thachin River Basin for entire basin study.

5.3.12 For further study, it is recommended that others river basin should be also studied as well because every river basin is important for water supply to local people which use natural water resources for domestic consumption.

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REFERENCE

Cronbach, Lee Josept. The Dependability of Behavioral Measurement: Theory of Generalizability for scores and profiles. By Lee J. Cronbach and other New York: Wiley, 1972.

Matsumura, F. (1995). Toxicology of insecticides. New York: Plenum Prees.

Staring, W.D.E. (1984). United and Social Commission for Asia and the Pacific. Bangkok, Thailand.

กองควบคุมโรคและวัสดุการเกษตร.(2532).สถิติสารกำจัดศัตรูพืชปี2531.กรุงเทพมหานคร: กรมวิชาการเกษตร. กระทรวงเกษตรและสหกรณ์.

กองวิเคราะห์โครงการและประเมินผล. (2522). รายงานการศึกษาวิเคราะห์ผลงานวิจัย อ้อย พ.ศ. 2518-2522. กรุงเทพมหานคร: กองวิเคราะห์โครงการและประเมินผล สำนักงานคณะกรรมการวิจัยแห่งชาติ กระทรวงวิทยาศาสตร์เทคโนโลยีและการพลังงาน.

กรมวิชาการเกษตร, กระทรวงเกษตรและสหกรณ์. (2538). พฤติกรรมการใช้สารเคมีของเกษตรกรและความสนใจในโครงการลดการใช้สารเคมีทางการเกษตร. กรุงเทพมหานคร: กองวัตถุมีพิษการเกษตร กรมวิชาการเกษตร.

_____. (2543). ก้าวสู่สหัสวรรษใหม่... กองวัตถุมีพิษการเกษตร.กรุงเทพมหานคร: กองวัตถุมีพิษการเกษตร กรมวิชาการเกษตร.

_____. (2547). การปลูกพืชไร่.กรุงเทพมหานคร: สถาบันวิจัยพืชไร่ กรมวิชาการเกษตร. กระทรวงเกษตรและสหกรณ์.

_____. (2526). มันสำปะหลัง. กรุงเทพมหานคร: บริษัท สหสารการพิมพ์ จำกัด.

_____. (2547). ข้าวโพดเลี้ยงสัตว์. กรุงเทพมหานคร: ชุมนุมสหกรณ์การเกษตรแห่งประเทศไทย.

_____. (2547). อ้อย. กรุงเทพมหานคร: หจก. ไอเดีย สแควร์.

_____. (2547). มันสำปะหลัง. กรุงเทพมหานคร: หจก. ไอเดีย สแควร์.

กรมส่งเสริมการเกษตร, กระทรวงเกษตรและสหกรณ์. (2531). ข้อควรระวังในการใช้ยาปราบศัตรูพืช. กรุงเทพมหานคร: โรงพิมพ์องค์การสงเคราะห์ทหารผ่านศึก.

คันธรส พวงแก้ว. (2542). การวิเคราะห์ประสิทธิภาพทางเศรษฐกิจและทัศนคติของเกษตรกรต่อการผลิตผักโดยใช้วิธีการป้องกันกำจัดศัตรูพืชแบบผสมผสาน การกางมุ้ง และการใช้

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สารเคมี ในจังหวัดสงขลา. วิทยานิพนธ์ปริญญาวิทยาศาสตรมหาบัณฑิต (เทคโนโลยีที่เหมาะสมเพื่อการพัฒนาทรัพยากร). มหาวิทยาลัยมหิดล.

จุไรรัตน์ เกิดดอนแฝก. (2537). ภัยมืดจากสารพิษ. กรุงเทพมหานคร: บริษัท เชษฐ สตูดิโอ แอนด์ กราฟิคดีไซน์ จำกัด.

ชุดา จิตพิทักษ์. (2525). พฤติกรรมศาสตร์เบื้องต้น. กรุงเทพมหานคร: สารมวลชน.

เชิดศักดิ์ เฉลียวศิลป์. (2541). พฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืชของเกษตรกรอำเภอสามพราน จังหวัดนครปฐม.วิทยานิพนธ์ปริญญาศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

ช่อทิพย์ ตันทวี. (2532). การรับรู้และความตระหนักเกี่ยวกับการใช้สารเคมีป้องกันกำจัดแมลงในเคหสถาน ของนักเรียนประถมศึกษาปีที่ 6 อำเภอเมือง จังหวัดนครปฐม. วิทยานิพนธ์ปริญญาศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

เทพพนม เมืองแมน และสวิง สุวรรณ. (2529). พฤติกรรมองค์กร. กรุงเทพมหานคร: ไทยวัฒนาพาณิชย์.

ธงชัย สันติวงค์. (2521). พฤติกรรมผู้บริโภค. กรุงเทพมหานคร:ไทยวัฒนาพาณิชย์.

ธรรมศักดิ์ สมมาตย์. (2526). สารป้องกันกำจัดโรคพืช. กรุงเทพมหานคร: โรงพิมพ์ทั่งฮั่วซิน.

นิตยา สุริยะเจริญ. (2533). พฤติกรรมการใช้ยาฆ่าแมลงของเกษตรกรอำเภอบ้านแพ้ว จังหวัดสมุทรสาคร. วิทยานิพนธ์ปริญญาศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

นวลศิริ เปาโรหิตย์. (2533). จิตวิทยาสังคม. กรุงเทพมหานคร: โรงพิมพ์มหาวิทยาลัยรามคำแหง.

ประเสริฐ ผลรัตน์. (2534). ความสัมพันธ์ระหว่างความรู้ ทัศนคติ และพฤติกรรมการใช้สารเคมีปราบศัตรูพืชของเกษตรกร กับอาการเจ็บป่วยทางร่างกาย: ศึกษากรณี สวนส้มเขียวหวาน. วิทยานิพนธ์วิทยาศาสตรมหาบัณฑิต.มหาวิทยาลัยมหิดล.

ปราโมทย์ แย้มพร้อม. (2539). การป้องกันอันตรายจากสารเคมีที่ใช้ในชีวิตประจำวัน สำหรับกลุ่มแม่บ้านอาสาสมัคร ในเขตอำเภอบางกรวย จังหวัดนนทบุรี. วิทยานิพนธ์ศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

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ฝ่ายจัดการสารพิษ. (2533). โครงการศึกษาเพื่อวางแผนควบคุมผลกระทบสิ่งแวดล้อมจากสารพิษ. กรุงเทพมหานคร. สำนักงานคณะกรรมการสิ่งแวดล้อมแห่งชาติ: กรทรวงวิยาศาสตร์เทคโนโลยีและการพลังงาน.

_____. (2531). โครงการศึกษาเพื่อวางแผนควบคุมผลกระทบสิ่งแวดล้อมจากสารพิษ. กรุงเทพมหานคร. สำนักงานคณะกรรมการสิ่งแวดล้อมแห่งชาติ: กรทรวงวิยาศาสตร์เทคโนโลยีและการพลังงาน.

ไพโรจน์ จ๋วงพานิช. (2525). หลักวิชาโรคพืช. กรุงเทพมหานคร: บริษัทสารมวลชน จำกัด.

พรนิภา ศรีสุวัฒนาสกุล (2531). การปฏิบัติเกี่ยวกับการใช้ยาฆ่าแมลงของเกษตรกรที่ปลูกผักในเขตตำบลบางบัวทอง อำเภอบางบัวทอง จังหวัดนนทบุรี. วิทยานิพนธ์ศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

วีระนารถ มานะกิจ. (2535). พฤติกรรมของบุคคลในองค์กร. กรุงเทพมหานคร: สำนักพิมพ์มหาวิทยาลัยรามคำแหง.

วาสนา สุขกุล. (2549). ความพึงพอใจของชาวบ้านที่อาจได้รับผลกระทบจากโครงการอ่างเก็บน้ำแม่ขาน. วิทยานิพนธ์วิทยาศาสตรมหาบัณฑิต. มหาวิทยาลัยมหิดล.

สุภัทศิริ พรสุรัตน์. (2543). ความตระหนักต่อพิษภัยจากสารเคมีป้องกันกำจัดศัตรูข้าว ของเกษตรกรอำเภอเมือง จังหวัดสุพรรณบุรี. วิทยานิพนธ์วิทยาศาสตรมหาบัณฑิต. มหาวิทยาลัยเกษตรศาสตร์.

สุภาณี พิมพ์สมาน (บรรณาธิการ). (2534). รายงานการสัมมนา การใช้สารจากพืชเพื่อการป้องกันกำจัดศัตรู ทางการเกษตร. ขอนแก่น: ขอนแก่นการพิมพ์.

สำนักงานเศรษฐกิจการเกษตร กระทรวงเกษตรและสหกรณ์. (2546). รายงานผลการสำรวจข้าวโพดเลี้ยงสัตว์ ปีเพาปลูก 2545/46. กรุงเทพมหานคร: สำนักงานเศรษฐกิจการเกษตร กระทรวงเกษตรและสหกรณ์.

_____. (2547). รายงานผลการสำรวจมันสำปะหลังปี 2547. กรุงเทพมหานคร: สำนักงานเศรษฐกิจการเกษตร กระทรวงเกษตรและสหกรณ์.

โสภา ชูพิชัยกุล. (2521). จิตวิทยาทั่วไป. กรุงเทพมหานคร: สำนักพิมพ์ไทยวัฒนาพาณิชย์.

เสาวนีย์ ใจเที่ยง. (2531). การศึกษาพฤติกรรมการใช้สารเคมีป้องกันกำจัดแมลงในเคหสถานของประชาชนในชุมชนแออัดกุศลทอง ยานนาวา กรุงเทพมหานคร. วิทยานิพนธ์ศึกษาศาสตรมหาบัณฑิต (สิ่งแวดล้อมศึกษา). มหาวิทยาลัยมหิดล.

อาณัติ ต๊ะปินตา. (2536). รายงานการใช้สารจากพืชเพื่อการป้องกันกำจัดศัตรูทางการเกษตร. ขอนแก่น: ขอนแก่นการพิมพ์.

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APPENDIX

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แบบสอบถาม

เรื่อง พฤติกรรมเกี่ยวกับการใช้สารเคมีป้องกันและกำจัดศัตรูพืช ของเกษตรกรผู้ปลูกมันสำปะหลัง อ้อย และข้าวโพดในพื้นที่จังหวัดชัยนาท และจังหวัดสุพรรณบุรี

วันที่..... เดือน..... พ.ศ. .....
ชื่อผู้ให้สัมภาษณ์.....
บ้านเลขที่ .....ชื่อหมู่บ้าน.....ตำบล.....
อำเภอ..... จังหวัด.....

ตอนที่ 1 ข้อมูลเกี่ยวกับลักษณะทั่วไปของเกษตรกร

กรุณาทำเครื่องหมาย ✓ ลงใน ☐ ที่กำหนดให้ ซึ่งตรงกับลักษณะของท่านมากที่สุด

1. เพศ

☐ 1. ชาย ☐ 2. หญิง

2. อายุ.....ปี

3. ระดับการศึกษา

☐ 1. ไม่ได้เรียน ☐ 2. ประถมศึกษาตอนต้น

☐ 3 . ประถมศึกษาตอนปลาย ☐ 4. มัธยมศึกษาตอนต้น

☐ 5. มัธยมศึกษาตอนปลาย ☐ 6. ปวช.

☐ 7. ปวส. ☐ 8. ปริญญาตรี

☐ 9. อื่นๆ ระบุ.....

4. รายได้ต่อปีจากอาชีพในการปลูกพืชไร่ (ในรอบปีที่ผ่านมา)

☐ 1. ต่ำกว่า 50,000 บาท ☐ 2. 50,000 - 100,000 บาท

☐ 3. 100,001 - 200,000 บาท ☐ 4. 200,001 - 300,000 บาท

☐ 5. 300,000 บาทขึ้นไป

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5. ขนาดพื้นที่เพาะปลูก

☐1. น้อยกว่า 5 ไร่ ☐2. 5-10 ไร่

☐3. 11-20 ไร่ ☐4. 20 ไร่ขึ้นไป

6. ลักษณะการถือครองที่ดิน

☐ 1. เจ้าของที่ดิน ☐ 2. ผู้อื่นให้ทำเปล่า

☐ 3. เช่าที่ดิน ☐ 4. อื่นๆ ระบุ.....

7. ประเภทพืชที่ปลูก

☐1. ผัก ☐2. ผลไม้

☐3. ผักและผลไม้ ☐4. อื่นๆ.....(ระบุ)

8. ข้อตกลงในการขายหรือจำหน่ายผลผลิต

☐1. ไม่มีข้อตกลง ขายหรือจำหน่ายได้ทุกแหล่ง

☐2. ต้องขายหรือจำหน่ายให้พ่อค้าคนกลางที่มารับซื้อ

☐3. ต้องขายหรือจำหน่ายให้องค์กรของรัฐ

☐4. อื่นๆ..... (ระบุ)

9. ประสบการณ์การประกอบอาชีพเกษตรกรรม เป็นเวลา..... ปี

10. แรงงานในการทำสวน มีทั้งหมด ..... คน

☐1. แรงงานคนในครอบครัว จำนวน ..... คน

☐2. แรงงานคนนอกครอบครัว จำนวน ..... คน

☐3. ผู้ใช้สารเคมีป้องกันและกำจัดศัตรูพืช ระบุ .....

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ตอนที่ 2 คำถามเกี่ยวกับปัจจัยกระตุ้นและปัจจัยทางสภาพแวดล้อม

1. ท่านรู้จัก GAP (Good Agricultural Practice) หรือไม่

☐ 1. รู้จัก ☐ 2. ไม่รู้จัก

2. ท่านรู้จัก GAP (Good Agricultural Practice) ครั้งแรกจากที่ใด

☐1. เพื่อนบ้าน/เพื่อนสมาชิกชมรม ☐2. เจ้าหน้าที่ของรัฐ ระบุ.....

☐3. วารสาร/หนังสือพิมพ์ ☐4. วิทยุ โทรทัศน์

☐4. อื่น ๆ .....

3. ท่านเคยได้รับความรู้เกี่ยวกับ GAP (Good Agricultural Practice) ในการปลูกพืชหรือไม่

☐ 1. เคย ☐ 2. ไม่เคย

4. ถ้าเคยท่านได้รับความรู้เกี่ยวกับ GAP (Good Agricultural Practice) จากแหล่งใดมากที่สุด

☐1. เพื่อนบ้าน/เพื่อนสมาชิกชมรม ☐2. เจ้าหน้าที่ของรัฐ ระบุ.....

☐3. วารสาร/หนังสือพิมพ์ ☐4. วิทยุ โทรทัศน์

☐4. อื่น ๆ .....

5. ปัจจุบันท่านได้ปฏิบัติตาม GAP (Good Agricultural Practice) ในการปลูกพืชหรือไม่

☐1. ใช้ เพราะ .....

☐2. ไม่ใช้ เพราะ .....

6. ท่านเคยได้รับข่าวเกี่ยวกับการใช้สารเคมีป้องกันและกำจัดศัตรูพืชบ้างหรือไม่

☐ 1.เคย ☐ 2.ไม่เคย

ถ้าเคยโปรดระบุแหล่งที่มาและความถี่

แหล่งข่าวสาร	ไม่เคย	เคย		
		นานๆครั้ง (เดือนละ 1 ครั้ง)	บ่อยครั้ง (สัปดาห์ละ 3-4 ครั้ง)	ทุกวัน
สื่อบุคคล 1. ตัวแทนจำหน่ายสารเคมี				
2. พนักงานเดินตลาด				
3. จ้าหน้าที่ของรัฐ				
4. เพื่อนบ้าน				

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แหล่งข่าวสาร	ไม่เคย	เคย		
		นานๆครั้ง (เดือนละ 1 ครั้ง)	บ่อยครั้ง (สัปดาห์ละ 3-4 ครั้ง)	ทุกวัน
สื่อมวลชน 5. โทรทัศน์				
6. วิทยุ				
7. หนังสือพิมพ์				
8. อินเตอร์เน็ต				
สื่อเฉพาะกิจ 10.เอกสาร วารสารเผยแพร่โฆษณา				
11. นิตยสาร				
12. ฉลากยา				

7. ท่านเคยเข้าร่วมฝึกอบรมเกี่ยวกับการใช้สารเคมีป้องกันและกำจัดศัตรูพืชหรือไม่

☐1. ไม่เคย

☐3. เคย เรื่อง ..... โดยหน่วยงาน .....

เรื่อง ..... โดยหน่วยงาน .....

เรื่อง ..... โดยหน่วยงาน .....

8. ปัจจุบันท่านซื้อสารเคมีป้องกันและกำจัดศัตรูพืชจากแหล่งใด

☐ 1.ร้านค้า ☐ 2.ตัวแทนจำหน่าย

☐ 3.สหกรณ์/กลุ่มในหมู่บ้าน ☐ 4.อื่น ๆ .....

9. ท่านใช้สารเคมีชนิดใดบ้างในการป้องกันกำจัดโรคพืชและปราบศัตรูพืช (ระบุชนิด/ ฤดูกาล)

1) ชื่อ ..... 2) ชื่อ .....

ฤดูกาล ..... ฤดูกาล .....

ปริมาณ ..... ปริมาณ .....

ความถี่ที่ให้ ..... ความถี่ที่ให้ .....

ช่วงเวลา ..... ช่วงเวลา .....

วิธีการให้ ..... วิธีการให้ .....

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3) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

4) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

5) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

6) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

7) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

8) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

9) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

10) ชื่อ .....
ฤดูกาล .....
ปริมาณ .....
ความถี่ที่ให้ .....
ช่วงเวลา .....
วิธีการให้ .....

10. ท่านใช้สารเคมีป้องกันและกำจัดศัตรูพืช มาเป็นเวลา ..... ปี

11. ท่านเคยแพ้สารเคมีหรือได้รับอันตรายจากสารเคมีป้องกันและกำจัดศัตรูพืชหรือไม่

☐1. เคย ☐ 2. ไม่เคย

12. ท่านเคยเจ็บป่วยอันเนื่องมาจากสารเคมีป้องกันและกำจัดศัตรูพืชหรือไม่

☐1. เคย ☐ 2. ไม่เคย

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13. ท่านทราบถึงอันตรายจากการใช้สารเคมีป้องกันและกำจัดศัตรูพืชหรือไม่

☐1. ทราบ ☐ 2. ไม่ทราบ

14. ท่านทำความสะอาดภาชนะและอุปกรณ์ที่ใช้สำหรับสารเคมีป้องกันและกำจัดศัตรูพืชอย่างไร

.....

15. ท่านบริโภคพืช/สัตว์ เช่น ผัก หนูนา ที่อยู่ในพื้นที่ทำการเกษตรของท่านหรือไม่

☐1. บริโภค ☐ 2.ไม่บริโภค

16. ท่านรู้จักเกษตรอินทรีย์หรือไม่

☐ 1. รู้จัก ☐ 2. ไม่รู้จัก

17. ท่านรู้จักเกษตรอินทรีย์ครั้งแรกจากที่ใด

☐1. เพื่อนบ้าน/เพื่อนสมาชิกชมรม ☐2. เจ้าหน้าที่ของรัฐ ระบุ.....

☐3. วารสาร/หนังสือพิมพ์ ☐4. วิทยุ โทรทัศน์

☐4. อื่น ๆ .....

18. ท่านเคยได้รับความรู้เกี่ยวกับเกษตรอินทรีย์หรือไม่

☐1. เคย ☐ 2. ไม่เคย

19. ถ้าเคยท่านได้รับความรู้เกี่ยวกับเกษตรอินทรีย์จากแหล่งใดมากที่สุด

☐1. เพื่อนบ้าน/เพื่อนสมาชิกชมรม ☐2. เจ้าหน้าที่ของรัฐ ระบุ.....

☐3. วารสาร/หนังสือพิมพ์ ☐4. วิทยุ โทรทัศน์

☐4. อื่น ๆ .....

20. ปัจจุบันท่านได้มีการประยุกต์ใช้เกษตรอินทรีย์ในการประกอบอาชีพหรือไม่

☐1. ใช้ เพราะ .....

☐2. ไม่ใช้ เพราะ .....

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ตอนที่ 3 ความรู้เรื่องการใช้สารเคมีป้องกันและกำจัดศัตรูพืช

คำถาม	ใช่	ไม่ใช่
1. การใช้สารเคมีป้องกันและกำจัดศัตรูพืช จำเป็นต้องทราบถึงชนิดและปริมาณศัตรูพืชที่กำลังทำลายพืชอยู่		
2. การผสมสารเคมี สามารถผสมสารเคมีได้ตามความต้องการของผู้ใช้โดยไม่ต้องปฏิบัติตามคำแนะนำของฉลากยา		
3. ก่อนผสมสารเคมีควรสวมถุงมือให้เรียบร้อยก็เพียงพอแล้ว		
4. ก่อนลงมือพ่นสารเคมี ควรสังเกตทิศทางลม ไม่พ่นทวนลม		
5. ในขณะที่ปฏิบัติงาน หากร่างกายปนเปื้อนสารเคมี จะต้องรีบล้างน้ำให้สะอาดโดยไม่ต้องฟอกสบู่ก็ได้		
6. การล้างเครื่องพ่นสารเคมีต้องระวังอย่าให้สารเคมีไหลลงบ่อน้ำเพราะจะเป็นอันตรายต่อปลาและสิ่งมีชีวิตอื่น		
7. เมื่อมีผู้ได้รับสารพิษจากสารเคมี ควรรีบนำส่งแพทย์ที่ใกล้ที่สุด พร้อมด้วยภาชนะบรรจุสารเคมีที่ใช้ไปให้แพทย์ดูด้วย		
8. การฉีดพ่นสารเคมีก่อนการเก็บผลผลิต 1 วัน จะทำให้ผักและผลไม้ มีความสดและมีรสชาติดี ราคาดี		
9.การเก็บรักษาสารเคมี ควรเก็บให้ห่างจากที่อยู่อาศัยและต้องไม่ปะปนอาหาร		
10. ในการที่เกิดไฟไหม้ ให้อพยพคนออกจากพื้นที่ ที่พิษของสารเคมีจะไปถึงโดยไม่ต้องแจ้งถึงชนิดของสารเคมีที่ถูกไฟไหม้ให้เจ้าหน้าที่ดับเพลิงทราบ		
11. เมื่อสารพิษของสารเคมีหกปนเปื้อนพื้นให้ใช้ทรายดูดซับแล้วนำไปทิ้งโดยการฝังดิน และ หลีกเลี่ยงไม่ให้ถึงระดับน้ำใต้ดิน		
12. เมื่อสารเคมีรั่วไหลมาเป็นจำนวนมาก ควรใช้ปูนขาวหรือขี้เถ้าที่มีคุณสมบัติเป็นด่างขจัดพิษเสียก่อน แล้วจึงนำไปฝังดินในที่ๆปลอดภัย		
13. ภาชนะที่บรรจุสารเคมีเมื่อใช้หมดแล้ว ล้างให้สะอาด สามารถนำมาบรรจุสิ่งของอย่างอื่นได		
14. ห้ามเผาพลาสติกหรือภาชนะบรรจุสารเคมีทุกชนิดที่มีความดัน เพราะจะทำให้เกิดการระเบิดได้		
15. สารเคมีที่เหลือจะไม่ใช้ต่อ จะต้องนำไปใส่หลุมลึกๆ ที่มีปูนขาวรองก้น		

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หลุมและห่างไกลจากแหล่งน้ำ		

ตอนที่ 4 ความรู้เรื่องอันตรายจากการใช้สารเคมีป้องกันและกำจัดศัตรูพืช

คำถาม	ใช่	ไม่ใช่
1. สารเคมีป้องกันและกำจัดสัตรูพืชนั้นมีความเป็นพิษในหลายระดับ เป็นพิษมาก หรือน้อย สามารถสังเกตแถบสีบนฉลาก ถ้าเป็นพิษมากจะเป็นแถบสีแดง		
2. อันตรายจากสารเคมีป้องกันและกำจัดศัตรูพืช เกิดขึ้นได้ 2 ลักษณะ คือ แบบเฉียบพลัน และแบบเรื้อรัง		
3. อาการที่เกิดจากการได้รับสารเคมีที่มีพิษน้อย จะมีอาการ คลื่นไส้อาเจียน ตัวสั่น แน่นหน้าอก เป็นตะคริวที่ท้อง และเหงื่อออกมาก		
4. อาการได้รับพิษจากสารเคมี มีอาการชัก หมดสติ ชีพจรเต้นช้า เป็นอาการของผู้ที่ได้รับสารเคมี ที่มีพิษร้ายแรง		
5. อาการได้รับพิษจากสารเคมี มีอาการปวดหัว อ่อนเพลีย น้ำตาไหล เป็นอาการของผู้ที่ได้รับสารเคมี ที่มีพิษปานกลาง		
6. การได้รับสารพิษจากประเภทสารหนู ภายหลังจากที่ได้รับสารเพียง 5 นาที ก็ทำให้เกิดอาการได้ และอาจถึงแก่ความตายภายใน 24 ชั่วโมง		
7. สารพิษประเภทปรอท จะมีอาการกระตุกตามปลายนิ้ว ปวดหัว เวียนศีรษะ		
8. พิษจากสารประเภทยาเบื่อหนู จะเกิดขึ้นได้ก็ต่อเมื่อกินเข้าไปเท่านั้น		
9. การขจัดสารเคมีที่สัมผัส กรณีปนเปื้อนตามผิวหนัง ให้ล้างบริเวณที่เปื้อนด้วยน้ำอุ่น หรือแอลกอฮอล์		
10. การทำให้สารเคมีหมดฤทธิ์ สารเคมีประเภทกรด ทำลายพิษโดยการดื่มนมสด		

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ตอนที่ 5 พฤติกรรมการใช้สารเคมีป้องกันและกำจัดศัตรูพืช

คำถาม	ปฏิบัติทุกครั้ง	ปฏิบัติบ่อยครั้ง	ปฏิบัติเป็นบางครั้ง	ไม่เคยปฏิบัติ
1. การซื้อสารเคมี ท่านได้เลือกซื้อสารเคมีที่มีฉลากถูกต้องตาม พระราชบัญญัติวัตถุมีพิษหรือไม่				
2. ก่อนใช้สารเคมี ท่านได้อ่านฉลากให้เข้าใจถึงวิธีการใช้โดยละเอียดหรือไม่				
3. ก่อนผสมสารเคมี ท่านได้ปฏิบัติตามคำแนะนำเคร่งครัดหรือไม่				
4. ก่อนการผสมและพ่นสารเคมี ท่านได้สวมเสื้อผ้าหมวก แว่นตา ถุงมือ และหน้ากากให้มิดชิดทุกครั้ง				
5. การฉีดพ่นสารเคมี ท่านได้ทำการฉีดพ่นทันทีโดยไม่ทิ้งไว้นานๆ หรือไม่				
6. การฉีดพ่นสารเคมี ท่านฉีดพ่นสารเคมีตามความต้องการของท่าน โดยไม่มีการคำนวณปริมาณการฉีดพ่นต่อไร่ต่อถัง ให้ถูกต้องหรือไม่				
7. ก่อนการลงมือฉีดพ่นสารเคมีท่านสังเกตและดูทิศทางลมหรือไม่				
8. การใช้เครื่องพ่นสารเคมี ท่านได้ใช้เครื่องที่ชำรุดและมีการรั่วไหลของสารเคมีหรือไม่				
9. ในขณะปฏิบัติงาน หากร่างกายเปียกเปื้อนสารเคมี ท่านได้รีบล้างและฟอกสบู่ให้สะอาดหรือไม่				
10. การล้างเครื่องพ่นสารเคมีหรืออุปกรณ์ ท่านได้ระมัดระวังมิให้น้ำไหลลงบ่อหรือไม่				
11.ท่านทิ้งระยะเวลาไม่พ่นสารเคมีก่อนเก็บผลผลิตไปขายตลาดตามระยะเวลาที่ระบุไว้ในฉลากหรือไม่				
12. บริเวณที่ท่านพ่นสารเคมีเสร็จแล้วท่านปิดป้ายบอกให้รู้ทั่วกันถึงวันที่พ่นสารเคมีติดไว้ประมาณ 6-7 วัน				

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คำถาม	ปฏิบัติทุกครั้ง	ปฏิบัติบ่อยครั้ง	ปฏิบัติเป็นบางครั้ง	ไม่เคยปฏิบัติ
13.เมื่อมีสารเคมีเปรอะเปื้อนท่านได้ใช้ขี้เลื่อยดูดซับแล้วนำไปฝังดินหรือไม่				
14. ท่านได้ใช้ปูนขาวหรือขี้เถ้าในการขจัดสารพิษเคมีที่รั่วไหลก่อนการนำไปฝังดิน				
15. การเก็บรักษาสารเคมีท่านได้เก็บสารเคมีในที่เหมาะสมและมีความปลอดภัยจากคนและสัตว์หรือไม่				
16. ท่านเผาพลาสติกหรือภาชนะบรรจุสารเคมีทุกชนิดที่มีความดันภายในหรือไม่				
17. ภาชนะบรรจุสารเคมีที่ใช้หมดแล้ว ท่านได้ทุบทำลายแล้วนำไปฝังกลบดินหรือไม่				
18. ภาชนะที่บรรจุสารเคมีที่ใช้แล้ว ท่านได้นำมาล้างแล้วนำไปบรรจุสิ่งของอย่างอื่นหรือไม่				
19. สารเคมีที่เหลือใช้ท่านได้นำไปใส่หลุมลึก ที่มีปูนขาวรองก้นหลุม และอยู่ห่างไกลจากแหล่งน้ำหรือไม่				

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