



UNIVERSITI PUTRA MALAYSIA

***HERBICIDE EXPOSURE AND SKIN SYMPTOMS AMONG PADDY
FARMERS INTANJUNG KARANG, SELANGOR***

**BY
RAIHANAH BT CHOKELI**

**Ip
FPSK4 2012 43**

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis. Special appreciation goes to my supervisor, Prof. Dr Zailina Hashim, for her supervision and constant support. Her invaluable help of constructive comments and suggestions throughout the experimental and thesis works have contributed to the success of this research. Not forgotten, my appreciation to my co-supervisor, Miss Vivien How for her understanding, encouraging and personal guidance have provided a good basis for the preparation of this thesis.

I would like to express my deeply grateful and highest appreciation to the citizens in Kampung Sawah Sempadan, Tanjung Karang Selangor for their support and help during my data collection at there. Sincere thanks to all my friends Mohd Izzat Othman and Hafida Baharum for their kindness and moral support during my study. Thanks for the friendship and memories.

Last but not least, my deepest gratitude goes to my beloved parents; Chokeli B Isa and Zahariah Ariffin and also to my sisters for their endless love, prayers and encouragement. To those who indirectly contributed in this research, your kindness means a lot to me. Thank you very much.

ABSTRACT

HERBICIDE EXPOSURE AND SKIN SYMPTOMS AMONG PADDY FARMERS IN TANJUNG KARANG, SELANGOR

Raihanah C., Zailina H., Vivien H.

Introduction: Skin symptoms due to pesticide exposure among paddy farmers were not commonly studied in Malaysia. This study has been carried out among 75 paddy farmers in Tanjung Karang, Selangor where it is the third largest paddy producer after Kedah and Perak. The common type of pesticides use in Tanjung Karang were 2, 4-D, Paraquat and Glyphosate for herbicide while Avisect and chlorpyrifos for insecticide. **Objective:** The aim of this study is to determine the relationship between dermal exposure and skin symptom among paddy farmers in Tanjung Karang. **Material and Method:** Fluorescent Tracer was used to trace the pesticide contaminant on the respondents' bodies. There are 2 types of scores that have been used to quantify the dermal exposures, namely the Exposure Evaluation Matrix (EEM) and Determinants of Dermal Exposure Ranking Method (DERM). A self-constructed questionnaire also used to record the socio-demographic background and the Modified Contact Dermatitis Questionnaire has been used to record the prevalence of skin symptoms among the respondents. **Result:** The result showed that the prevalence of body part exposed are mostly observed on right finger (36.6%) and back of thorax (35.2%). There was a significant association between skin symptoms and dermal exposures among the exposed group ($p < 0.05$). However, there were no association between skin symptoms with dermal exposures as measured by EEM as ($p > 0.05$) and DERM ($p > 0.05$). From the 7 skin symptoms reported among the exposed group, only itchiness (20%) showed the highest prevalence among the respondents followed by skin redness (10.5%). **Conclusion:** Multiple Linear Regressions showed that the itchiness, skin redness and rashes were significantly influenced by the how many hours and days of farmers using the pesticide. The tools that had been used to measure the dermal exposure such as EEM and DERM may not be reliable and sensitive for measuring pesticide exposure.

Keyword: Herbicides; Paddy Farmers; Skin Symptoms; Dermal Exposure;

ABSTRAK

**PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI
KALANGAN PESAWAH PADI DI TANJUNG KARANG SELANGOR****Raihanah C., Zailina H., Vivien H**

Pendahuluan: Kajian mengenai simptom kulit akibat pendedahan kepada racun rumpai di kalangan pesawah padi tidak banyak dilakukan di Malaysia. Kajian ini telah dilakukan di kalangan 75 pesawah padi di Tanjung Karang, Selangor di mana sawah padi yang ketiga terbesar selepas Kedah dan Perak. **Objektif:** Tujuan kajian ini adalah untuk menentukan hubungan antara pendedahan kulit dan simptom kulit di kalangan penanam padi di Tanjung Karang. **Bahan dan Kaedah:** Pengesanan Pendarfluor telah digunakan untuk mengesan kesan racun perosak pada badan responden. Terdapat 2 jenis skor yang telah digunakan untuk menilai pendedahan kulit, iaitu Pendedahan Penilaian Matrix (yang ditunjukkan pada) dan Penentu Pendedahan Dermal Kedudukan Kaedah (DERM). Satu soal selidik yang dibina juga digunakan untuk mencatat latar belakang sosio-demografi dan simptom kulit. **Keputusan:** Hasil kajian mendapati bahawa tiada terdapat hubungan yang signifikan antara gejala kulit dan skor kulit di kalangan kumpulan terdedah (P -nilai > 0.05). Prevalens bahagian badan yang terdedah adalah jari kanan (36.6%) dan belakang toraks yang (35.2%). Kegatalan adalah simptom yang paling banyak dilaporkan di kalangan responden (20%) diikuti oleh merah kulit (10.5%) **Kesimpulan:** Tiada perbezaan yang signifikan antara gejala kulit dan pendedahan kulit di kalangan kumpulan terdedah. Regresi Linear Berganda menunjukkan bahawa hanya gatal, ruam dan gejala kulit menunjukkan perbezaan yang signifikan dengan pemboleh ubah terpilih dan menunjukkan hubungan yang positif dengan semua pemboleh ubah yang terpilih.

Kata Kunci: Racun Rumpai; Pesawah Padi; Simptom Kulit; Pendedahan Kulit

TABLE OF CONTENTS

| | Page No. |
|----------------------|----------|
| DECLARATION | ii |
| APPROVAL | iii |
| ACKNOWLEDGEMENT | iv |
| ABSTRAK | v |
| ABSTRACT | vi |
| TABLE OF CONTENTS | vii |
| LIST OF TABLE | xii |
| LIST OF FIGURE | xiii |
| LIST OF APPENDICES | xiv |
| LIST OF ABBREVIATION | xv |

CHAPTER 1: INTRODUCTION

| | |
|------------------------------|----|
| Introduction | 1 |
| 1.1 Background | 1 |
| 1.2 Problem Statement | 6 |
| 1.3 Study Justification | 8 |
| 1.4 Conceptual Framework | 9 |
| 1.5 Research Objectives | 12 |
| 1.5.1 General Objective | 12 |
| 1.5.2 Specific Objectives | 12 |
| 1.6 Study Hypothesis | 13 |
| 1.7 Definition Of Term | 12 |
| 1.7.1 Conceptual Definition | 14 |
| 1.7.2 Operational Definition | 16 |

| | |
|--|----|
| CHAPTER 2: LITERATURE REVIEW | 19 |
| 2.1 Pesticides | 19 |
| 2.2 Herbicides | 22 |
| 2.3 Evaluation of dermal exposure by using Florescent Tracer dye | 23 |
| 2.4 Skin effects | 24 |
| CHAPTER 3: METHODOLOGY | 27 |
| 3.1 Study Location | 27 |
| 3.2 Study Design | 27 |
| 3.3 Sampling | 27 |
| 3.3.1 Sample Population | 27 |
| 3.3.2 Sample Frame | 27 |
| 3.3.3 Sample Study | 28 |
| 3.4 Instrumentation | 31 |
| 3.4.1 Approval Letter | 31 |

| | |
|---|----|
| 3.4.2 Questionnaire | 31 |
| 3.4.3 Visual Scoring Systems And Fluorescent Tracers | 41 |
| 3.5 Data Analysis | 42 |
| 3.6 Quality Control | 43 |
| 3.7 Ethical Consideration | 43 |
| CHAPTER 4: RESULT | |
| 4.1 Study Location | 44 |
| 4.2 Process of Paddy Cultivation | 47 |
| 4.3 Study Sample | 49 |
| 4.3.1 Respondents' background | 50 |
| 4.3.2 Lifestyle of exposed and control group | 51 |
| 4.3.3 Information on the types of pesticide used, working activities and equipment used among of farmers in paddy field | 52 |
| 4.4 Prevalence of personal protective equipment (PPE) used among the farmers | 54 |

| | |
|---|----|
| 4.5 Prevalence of body part exposed to pesticide during work activities | 58 |
| 4.6 Skin symptoms among respondents. | 62 |
| 4.7 Prevalence of skin symptoms among the respondents | 63 |
| 4.8 Period of skin symptom appears after the exposures | 64 |
| 4.9 Association between dermal exposures with skin symptoms among the exposed group | 65 |
| 4.10 Selected variables that influenced skin symptoms among exposed group | 69 |
| 4.10.1 The factors related with itchiness due to herbicide exposure among paddy farmers | 69 |
| 4.10.2 The selected factors related with rashes due to herbicide exposure among paddy farmers | 72 |
| 4.10.3 The selected variables related with redness due to herbicide exposure among paddy farmers | 74 |
| 4.10.4 The selected variables related with total of the skin symptoms due to herbicide exposure among paddy farmers | 76 |
| CHAPTER 5: DISCUSSION, RECOMMENDATION AND CONCLUSION | |
| 5.0 Discussion | 79 |
| 5.1 Subject and Methods | 79 |
| 5.2 Fluorescent Tracer kit and Visual Scoring Systems | 80 |

| | |
|---|----|
| 5.2 Prevalence of body part exposed to the pesticide during the work activities. | 82 |
| 5.3 Prevalence of personal protective equipment(PPE) used by respondents | 84 |
| 5.4 Prevalence of skin symptoms among the respondents. | 85 |
| 5.5 Association between dermal exposures with skin symptoms among the exposed group | 87 |
| 5.6 Selected variables influence skin symptoms among exposed group | 89 |
| 5.7 Recommendation | 90 |
| 5.8 Conclusion | 91 |
| LIST OF REFERENCES | 92 |
| APPENDICES | 96 |

LIST OF TABLE

| Table | Caption | Page |
|--------------|---|-------------|
| Table 2.0 | Total Case and Death of Pesticide in the Tanjung Karang: 2005-2010 | 21 |
| Table 3.1 | Body Segment Define For Total Visual Score | 36 |
| Table 3.2 | The Exposure Evaluation Matrix | 38 |
| Table 4.1 | Sociodemographic characteristics of the respondents | 50 |
| Table 4.2 | Lifestyle of exposed and control group | 51 |
| Table 4.3 | Information of pesticide use in paddy field | 53 |
| Table 4.4 | Prevalence of personal protective equipment (PPE) used among the exposed group | 56 |
| Table 4.5 | Skin symptom among respondents | 62 |
| Table 4.6 | Prevalence of skin symptoms among the respondents | 63 |
| Table 4.7 | Period of skin symptom appears after the exposures | 64 |
| Table 4.8 | The association between dermal exposures with skin symptoms among the exposed group | 67 |
| Table 4.9 | Selected variables influence itchiness among exposed group | 68 |
| Table 4.10 | Selected variables influence rashes among exposed group | 71 |
| Table 4.11 | Selected variables influence redness among exposed group | 73 |
| Table 4.12 | Selected variables influence pain among exposed group | 77 |

LIST OF FIGURE

| Figure | Caption | Page |
|---------------|---|-------------|
| Figure 2.0 | Conceptual framework of the study | 19 |
| Figure 3.0 | The 31 body segments distributed in the Anterior and Posterior of the total body area. | 34 |
| Figure 3.1 | Example of scoring contamination of the left palm | 37 |
| Figure 3.2 | The flow of the scheme of the DREM algorithm. | 40 |
| Figure 4.0 | Location of sub district of Selangor state. | 46 |
| Figure 4.1 | Process of Paddy Cultivation | 48 |
| Figure 4.2 | The clothes and personal protective equipment used by the respondents. | 57 |
| Figure 4.3 | Bodies' parts exposed to the pesticide during the work activities. | 58 |
| Figure 4.4 | The most exposed body part from the anterior view of the respondent | 59 |
| Figure 4.5 | The most exposed body part from the posterior view of the respondent | 60 |
| Figure 4.6 | The picture of pesticide dyed with fluorescent tracer, observed by using UV light in the dark room. | 61 |

LIST OF APPENDICES

| Appendices | Caption | Page |
|-------------------|---|-------------|
| Appendix 1 | Gantt Chart | 93 |
| Appendix 2 | Measurement techniques, flow charts, data collection and analysis | 94 |
| Appendix 3 | Map of Kampung Sawah Sempadan(Block) | 95 |
| Appendix 4 | Subject information sheet (Bahasa Malaysia) | 96 |
| Appendix 5 | Questionnaire (Bahasa Malaysia) | 100 |
| Appendix 6 | Ethic Approval Letter | 112 |

LIST OF ABBREVIATIONS

| | |
|----------------|--------------------------------------|
| < | Less than |
| > | More than |
| = | Equal to |
| % | Percent |
| N | Sample size |
| r | Correlation |
| R ² | R square |
| SD | Standard deviation |
| et al. | And others |
| EEM | Evaluation Exposure Matrix |
| DERM | Determinants Exposure Ranking Method |
| PPE | Personal protective equipment |
| TVS | Total Visual Score |

CHAPTER 1

INTRODUCTION

1.1 Background

Pesticides are widely used in agricultural production to prevent or control pests, diseases, weeds and other plant pathogens in an effort to reduce or eliminate yield losses and maintain high produce quality. Malaysian Government has spent million dollars to develop agricultural sector mainly to increase farmer's income, enhance the productivity and provide employments. Agriculture is considered as one of the most important sectors in Malaysia, and remains so despite the shifts in government economic strategies toward industrialization over the years. The term "paddy" or *Oryza Sativa* refers to rice cultivated in low land with irrigation. Rice (*Oryza sativa*), the staple food crop of the world, is generally grown by transplanting or wet direct seeding under lowland flooded irrigation system (Bouman and Tuong, 2000; Cantrell and Hettel, 2005). Rice farming in Malaysia can be regarded as one of the first irrigated rice production systems observed in Asia. Rice is a highly protected crop in a strategically important industry in Malaysia. Rice is a crucial part of everyday Malaysian diet. Malaysia produced 1.94 million metric

tons of rice annually (www.nationsencyclopedia.com, 2011). According to the Malaysian Agricultural Research and Development Institute (MARDI), 2003, there are approximately 296,000 paddy farmers in Malaysia, of which 116,000 are full-time farmers who depend on paddy cultivation for their livelihood. Of the paddy farmers, 65 per cent have farms of less than one hectare, while only 4 per cent have more than three hectares.

Use of pesticides in the agriculture sector poses a serious environmental and public health problem nowadays. According to United States Environmental Protection Agency (USEPA, 2009), pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests.

Herbicide is used to control weeds or kill unwanted plants. Some herbicides will eliminate every plant they touch, while others are designed to eradicate only specific types. Nonselective types of herbicides are use on railroad tracks or to control weeds around industrial areas. Selective herbicides are designed to kill broad leaf plants and weeds. Herbicides are believed to present a bigger threat because they are highly

concentrated in the water supply, due to runoff from agricultural use. The prevalent exposure of the world's populations to these substances has caused concern over their potential health consequences. These consequences are especially alarming as their effects are believed to induce devastating and life-long diseases, and deformities in children and unborn fetuses (Chester *et al.*, 1993).

Herbicide has become an attractive alternative to manual weeding due to its high efficacy and low cost. used are includes Paraquat, 2, 4-dichlorophenoxyacetic acid, Glyphosate, Most farmers in Malaysia are presently using herbicides as an effective tool in controlling weeds in wet direct seeded or transplanted rice (Karim *et al.*, 2004). The types of herbicides that are commonly used are Acetochlor, Atrazine, Dicamba, Mecoprop, Metolachlor, Pendimethalin and Propanil. Herbicide is the most effective and economic means of weed control, but inappropriate or wrong application may not only increase production cost and yield penalty but also may cause development of herbicide resistant weeds and environmental hazard (Karim *et al.*, 2004). Repeated use of same herbicide in the same field had often led to the occurrence of herbicide resistant weeds (Kim, 1996) and therefore, selection of herbicides with different mode of actions is also necessary for alternate application to avoid development of herbicide resistance in weeds. Herbicide mixtures may help prevent resistance problem as well as shift in weed population (Wrubel and Gressel, 1994).

The issues of use of pesticides in Malaysia have caused serious concern. Most of the farmers generally do not care or are not aware of potential pesticide hazards, apply higher than recommended concentrations, do not pay attention to pesticide labels, wear no protective clothing, and do not observe recommended intervals between spraying and harvest. (Vincent, *et al.*1993)

With Malaysia's need to increase food production to cater for its increasing population and the rapid growth of its cash crop industry, consumption of pesticides has markedly increased. While Malaysia moves towards industrialization, agriculture is still a significant component of its economy. This situation is similarly true for most other developing countries. In fact, most multinational agrochemical companies are actively targeting the expanding markets in these developing countries. Therefore, it is important for health scientists in developing countries like Malaysia, to monitor the health impacts of increasing pesticide use among their farmers (Stanley *et al*, 2005)

Since 1991, the number of pesticide poisoning cases increased to 1270, with 394 deaths. 278 of the 893 cases of pesticides poisoning reported from government hospitals throughout Malaysia were fatal (Ministry of Health Malaysia. 1991). Exposure to pesticides was found to be associated with a variety of common symptoms of chemical poisoning, ranging from mild effects such as skin irritation, nausea and vomiting, to even death (Jeyaratnam *et al.*, 1992.). A study conducted in Malaysia reported that 43%

of pesticide users experienced symptoms such as headache, drowsiness, vomiting, breathing difficulties, skin and eye irritation.

In the district of Tanjung Karang in the State of Selangor where the study took place, paddy cultivation has become the identity of the community as paddy is the main crop. Tanjung Karang is the largest paddy producer in Selangor after Kedah. It has a population of 39857 people and comprises of 90% Malays, 8% Chinese and the rest are Indians. The Chinese live in the urban area and involved in business or retailing. The Malays and Indians live in the rural areas performed agricultural activities, particularly rice cultivation. The areas have been selected on account of it being the third largest area of paddy field in Peninsular Malaysia. It is also known as 'the rice bowl of Selangor'. It covers 14,848 acres of rice field with 2194 families of farmers and producing an average of 3.8 ton of rice per hectare per year. These paddy fields are worked by the Bumiputera. This paddy field at Kampung Sawah Sempadan spans an area of approximately 2,300 hectares of Tanjung Karang sub district.

1.2 Problem statement

Work-related pesticide poisoning remains a pressing public health concern worldwide, especially in less developed countries (Sanborn *et al.*, 2001). The World Health Organization (WHO) reported that about one million serious unintentional pesticide poisoning occur each year (Jeyaratnam, 1990). A study of agricultural workers in developing regions of Asia estimated that as many as 25 million cases of mild pesticide poisoning occur annually. A significant hurdle to the control and prevention of work-related pesticide poisoning is that the scope and magnitude of this issue often remains uncharacterized, particularly in an underserved population such as farmers (Sanborn *et al.*, 2001).

A 2004 article "Toxicology Review" implicated glyphosate, the active ingredient in the popular weed killer Roundup, in causing rashes along with a variety of other health problems. Skin irritations are some of the most common effects when a person comes into contact with herbicides, and are most likely to happen on exposed areas, such as the hands and forearms. Some chemicals may burn the skin and should be washed off immediately with cold water. A number of herbicides have been associated with irritation of the skin: rashes, itching and general irritation. In the paddy-growing areas in Malaysia, the herbicides 2, 4-D and paraquat are most commonly used by the farmers (Nashriyah *et al.*, 2004). The pesticide 2, 4-D is a systemic herbicide used for post emergence control of annual and perennial broad-leaved aquatic weeds in paddy

fields (Soon *et al.*, 1994). Paraquat, a contact, non-selective herbicide, is effective in controlling a wide range of grassy and broad-leaved weed herbicides are listed under class II in the World Health Organization (WHO) classification, which means they are moderately hazardous to human health.

The study that has been conducted in Philippines shows that the incidence of skin problems is positively related to the use of both insecticides and herbicides, although only the latter are significant. This is because most herbicides used in the Philippines are acetamides, and unprotected use of these chemicals is known to cause skin problems. Farmers at the sample average for age and nutritional status who do not apply any herbicides have a probability of 0.12 of having skin problems. The probability of skin problems rises to 0.30 for farmers with one herbicide application and 0.50 for farmers with two applications (Pingali *et al.*, 1994).

In Tanjung Karang itself, Rengam *et al.*, (1991) has noted in their study that 72% of rice farmers experienced poisoning symptoms when handling pesticides, and proper clothing, goggles, shoes and respiratory masks were seldom worn.

1.3 Study Justification

A growing concern over the impact of escalating use of pesticides in the Malaysian agricultural industry on public health and safety prompted this study which was carried out in Tanjung Karang, Selangor. In Malaysia context, there is an obvious need to establish a mechanism for collating all statistics on the health and safety-related aspects of pesticide use. While research to improve application technology, education, and communication continues, work on exposure and ecological contamination in relation to human health must be given additional emphasis and support. There is insufficient emphasis on investigations into the acute and chronic effects of pesticides on both the farmer-user and the consumer population at large.

Until now, there are only a few studies of pesticide usage especially on herbicides including paraquat and glyphosate with their effects on skin, particularly among paddy farmers in Malaysia. As the consumption of pesticides has markedly increased year by year, it is important for health scientists in developing countries like Malaysia, to monitor the health impacts of increasing pesticide use among their farmers.

Through this study, emphasis will be given to dermal effect of herbicides used in the paddy farm, exposure through direct skin penetration and its effects on paddy

farmers' skin, in context skin symptoms. Thus, at the ends of the study, it hopes that all the information and results including the prevalence of skin symptoms among the paddy farmers can be the baseline study or references in Malaysia, especially in agriculture fields. The outcome of the study will be the skin effects due to exposure of herbicides can be used to improve the workers performances, including the awareness on health effects of the herbicides among the paddy farmers. This is because most of the farmers are not aware of the effects that they use during their works activities. The chemical used in paddy field follow the norms, which is the faster chemical can kills the pests, the better pesticides ,thus preference is usually given to it.

1.4 Conceptual Framework

Figure 1.0 shows that the conceptual framework of research activities. This will use to assist and guide researcher in conducting the study. The aim of this study is to determine the relationship between the dermal exposure to herbicides and the skin related symptoms among the paddy farmers in Tanjung Karang, Selangor.

From the framework, herbicides is one types of the pesticides that is usually used in the agriculture group, the exposure will be measured among paddy farmers only. There are three pathway that the herbicides can enter human body that is by consuming the contaminated food or water with herbicides (ingestion), by inhaling the contaminated air with herbicides and by direct skin contact with the herbicides or contaminated air with

herbicides .The exposure will give adverse health effect to human organ system such as to their respiratory system, cardiovascular system and also to the nervous system.

This research will focus on the effect of herbicides exposure to the worker's skin, where the exposure level of herbicides that they use during their work activities will be measured by using visual scoring systems and fluorescent tracers to get the Total Visual Scores (Fenske et al, 1990). From this test, it will be visually demonstrate to the paddy farmers about the exposure during them handling the pesticides, and also we will know which of the body part of the farmers that are mainly exposed to the pesticides while the working activities. On the other part, the effect on the skin will be observed and determined by using Modified contact-dermatitis questionnaire (Mc Gill University Health Care, 1999)

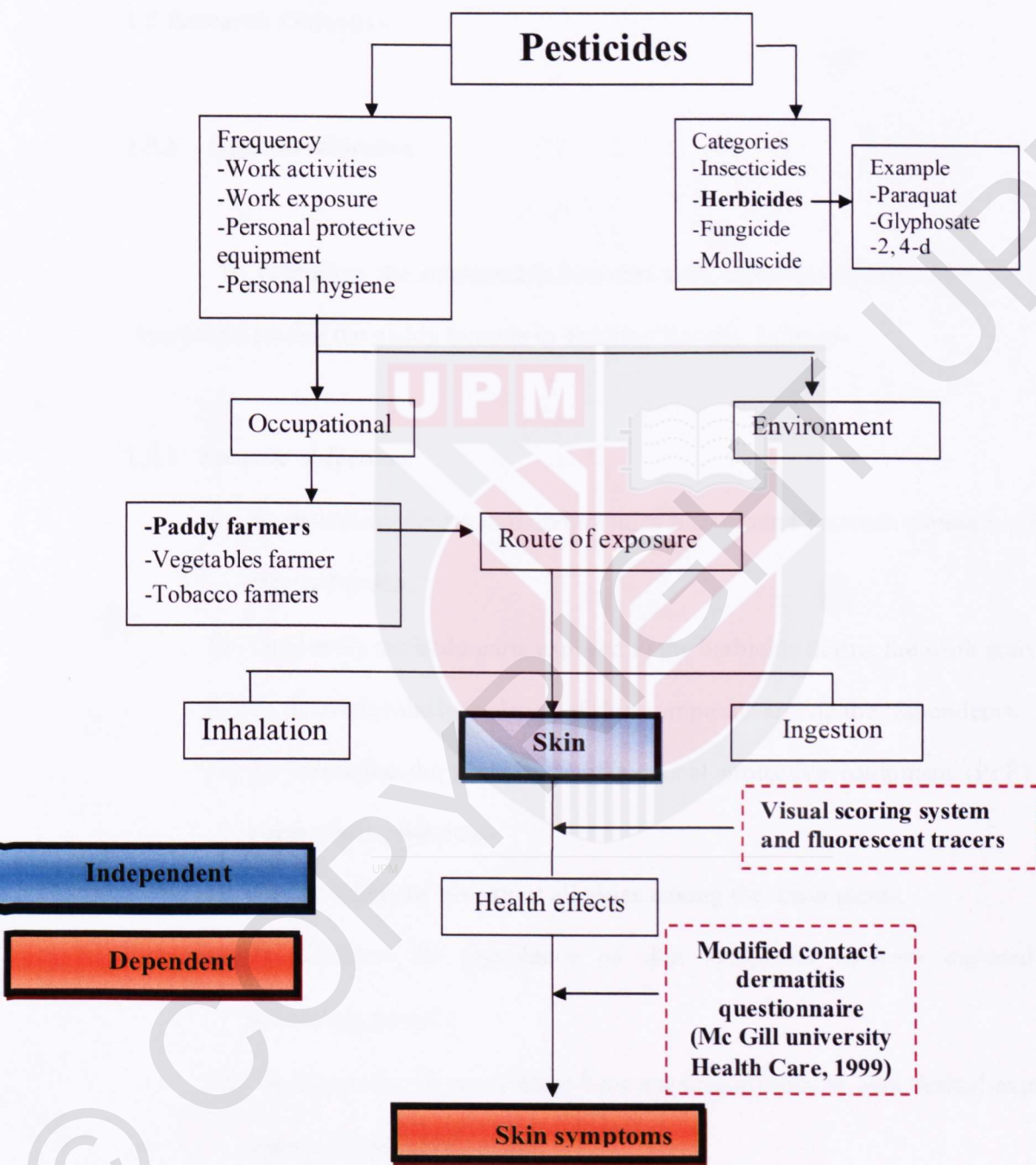


Figure 1.0: The conceptual framework of the research

1.5 Research Objective

1.5.1 General Objective

To determine the relationship between skin exposure to herbicides with skin symptoms among the paddy farmers in Tanjung Karang, Selangor.

1.5.2 Specific objectives

- i) To determine the socio demographics background between exposed and non exposed group.
- ii) To identify the body parts exposed to the herbicide during the work activities.
- iii) To determine the prevalence of skin symptoms among the respondents.
- iv) To determine the prevalence of personal protective equipment (PPE) used among the respondents
- v) To determine the history of allergies among the respondents.
- vi) To compare the prevalence of skin symptoms between exposed and unexposed group.
- vii) To determine the association between skin symptoms with dermal exposure among the exposed group.

To determine the selected variables that significantly influences the prevalence of skin symptoms.

1.6 Study Hypothesis

- i) The prevalence of skin symptoms is significantly higher among the exposed group compared than the unexposed group
- ii) The skin symptoms are significantly associated with body exposure among the study group.
- iii) The prevalence of skin symptoms are highly associated with selected variables.

1.7 Definition of term

1.7.1 Conceptual Definition

1.7.2 Pesticide

According to World Health Organization (WHO), pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds). Pesticides are used in public health to kill vectors of disease, such as mosquitoes, and in agriculture, to kill pests that damage crops. By their nature, pesticides are potentially toxic to other organisms, including humans, and need to be used safely and disposed of properly.

Pesticides can be divided into several groups, such as insecticides, fungicides, herbicides and rodenticides, depending on the target organs. Those that have been specifically designed for a purpose often utilize a particular biological, metabolic or other feature of the target species, but unfortunately some of the features are rarely entirely unique to that species so sometimes other similar species can also be affected.

a) Route of exposure

Exposure is the critical connection between potentially harmful factors of substances like pesticides. According to California Department of Pesticide Regulation (2009), scientists consider the likely routes of exposure, primarily inhalation of air containing dusts and vapors, skin (dermal) contact either with the pesticide directly spilled on skin or contact with foliage, soil, or other surfaces (e.g., household furniture, carpets) on which residues may be present, and ingestion of foods and water with pesticide residues.

b) Skin symptom

According to Canadian Centre for Occupational Health and Safety (2008), dermatitis is a localized inflammation of the skin. In general, inflammation refers to a condition in the body when it is trying to react to a localized injury of tissues. Signs of inflammation include some or all of the following: redness, heat, swelling and pain.

Occupational irritant contact dermatitis is an inflammation caused by substances found in the workplace that come in direct contact with the skin. Signs of irritant contact dermatitis include redness of the skin, blisters, scales or crusts. These symptoms do not

necessarily occur at the same time or in all cases. This kind of dermatitis is caused by chemicals that are irritating to the skin and is localized to the area of contact.

Another kind of contact dermatitis, allergic contact dermatitis, is different because it is an allergic response to skin contact with some allergy-causing material (e.g., poison ivy). Another difference is that allergic dermatitis can occur in other places on the body that did not come in contact with the allergy-causing material

1.7.2 Operational Definition

a) Pesticide

Herbicides are some of the most widely used pesticides in the world. They are used in agriculture, homes, gardens and veterinary practices, replacing the same uses as the organochlorine, many of which have been banned for years (Frederick *et al*, .2011). In general, they are not persistent in the environment as they break down quickly. Herbicides are widely used and readily absorbed through the skin. Occupational exposure limits (ACGIH, 2001; HSE, 2001; DFG, 2001) for herbicides usually have 'skin' notations to warn of the potential for dermal absorption to contribute to systemic toxicity.

b) Skin exposure

Skin is the most exposed organ while spraying the pesticide on fields (Ann Agriculture Environmental Medicine 2001). Skin is the primary route of exposure to pesticides, particularly while spraying, but also while handling pesticides in other ways. Excluding acute pesticide intoxications, the most common adverse effect of pesticides is said to be contact dermatitis. Potential dermal exposure is the total amount of pesticides landing on the body, including clothing, but the actual exposure of the skin will depend on the amount deposited directly on the skin plus any that penetrates clothing and is therefore available on the skin for absorption into the body. The risk of skin exposure to plant treatment products and pesticides has long been studied (Brouwer et al., 1992)

The most common one is contact dermatitis which is caused by pesticide exposure can be of either irritant or allergic type. These include individual susceptibility, other work-associated exposures such as to plant materials, solvents, fuels, rubber, cleansers, creams, moisture, and cold temperatures, physical abrasion of skin, as well as pre-existing skin disorders (Muddy et al, 1990). In this study, to measure dermal exposure of workers, Fenske's semi-quantitative 'Visual Scoring System' of fluorescent tracer will be used during the data collection. The use of the tracer has helped to demonstrate the non-uniformity of exposure, which is a substantial source of uncertainty in dermal exposure and risk assessment (Fenske et al, 1990).

c) Skin symptom

Dermatitis, inflammation of the skin, is generally accepted as the most commonly reported effect of pesticide exposure. Symptoms range from a slight redness of the skin to blisters or ulcerated lesions. The severity of the irritation is influenced by the chemical properties of the substance, duration and method of exposure, condition of the skin, temperature and humidity, and location of the contact on the body (Iowa Dept. of Public Health, 2011).

For acute dermal effects, pesticides may cause the skin to itch, blister, crack, or change color after exposure for the short period or just after applying it. Sometimes, the skin problems among farmers are not only because of pesticides, they might be caused by an allergic reaction to the plant itself, insect bites, allergic to certain substances or skin allergic to another reason such as food. Special tests such as patch tests are usually used to detect the reason of the skin allergy among farmers, but the test is usually rarely done to them. Generally, if skin rashes appear after exposure to pesticides and the skin becomes normal back after they stop from the exposure, it might be that the pesticides are the cause of the skin problems (www.extension.umn.edu, 2011)

CHAPTER 2

LITERATURE REVIEW

2.1 Pesticides

According to U.S Environmental Protection Agency (US EPA), pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pesticides are often applied only to chemical agents. Pesticides consist of insecticides, nematocides, fungicides, herbicides, and rodenticides, which is the agents primarily effective against insects, nematodes (or roundworms), fungi, weeds, and rodents, respectively.

Prevalence of pesticide poisoning in Malaysia has been studied before. In general, epidemiologic description of poisoning in Malaysia is hindered by lack of coordination in data collection. The best sources of information have been in-patient data and laboratory reports from government hospitals and records from the Chemistry Department of the Ministry of Science, Technology and the Environment. Data from this Ministry from 1979 to 1986 suggest that most poisonings are due to pesticides: mainly the widely used herbicide, paraquat (Figure 2.0). Ministry of Health information indicates that, in some cases, multiple agents are involved. Circumstances surrounding these poisonings show that 49.1 % were intentional and 37.8% were accidental.

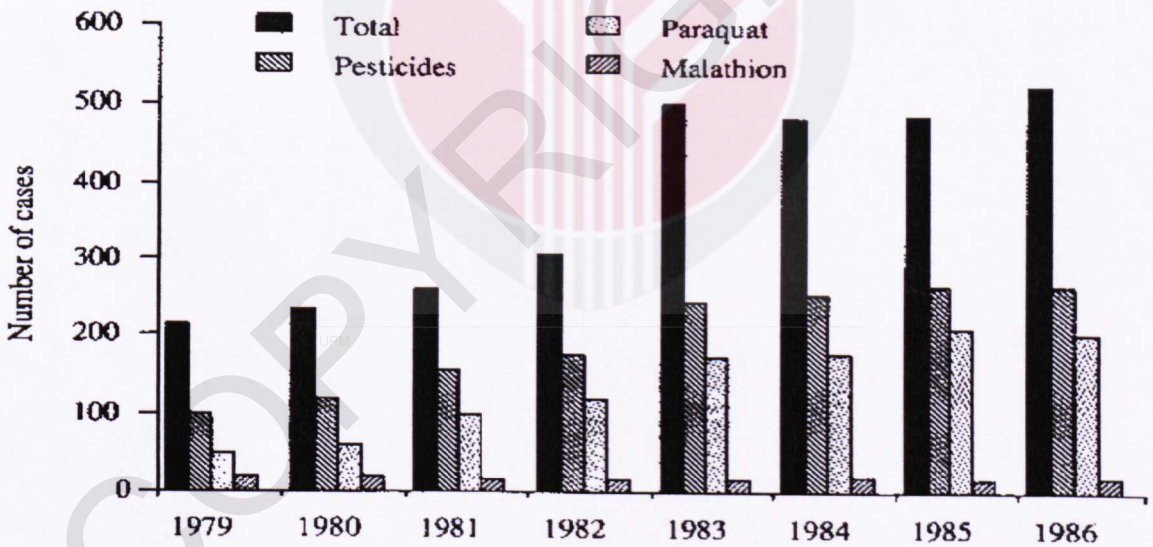


Fig.2.0: Cases of poisoning from pesticides, Malathion, Paraquat, and all substances in Malaysia, 1978-1986 (Lum *et al.*1990).

From the very recent study done by Fuad et al.,(2012) I Tanjung Karang, the farmers affirm that the pesticides used are poisonous and dangerous. A few hazardous effects have been detected. A number of serious cases reported was the incidence of the farmers who collapse, stomachache and vomiting. They were admitted to hospital. The effect of hazardous usage of modern agriculture has been proven according to the recorded data by District Hospital of Tanjung Karang (Table 2.0). There are farmers getting poisoned each year, for instance the highest case was in 2009 with a number of 24 cases and involving 2 deaths. It was followed by 19 cases and one death in 2006. They find out that the case had increased between February to April and final week of June until middle November due to the cultivation and treatment of the paddy plant.

Table 2.0: Total Case and Death of Pesticide in the Tanjung Karang: 2005-2010

| Year | Total case | Total death | Year | Total case | Total death | Year | Total case | Total death |
|-------|------------|-------------|------|------------|-------------|------|------------|-------------|
| 2005 | | | | 17 | | | 2 | |
| 2006 | | | | 19 | | | 1 | |
| 2007 | | | | 09 | | | 3 | |
| 2008 | | | | 17 | | | 3 | |
| 2009 | | | | 24 | | | 2 | |
| 2010 | | | | 08 | | | 3 | |
| Total | | | | 94 | | | 14 | |

Source: District Hospital Tanjung Karang, 2011

2.2 Herbicide

Herbicides can be defined as crop protecting chemicals used to kill weedy plants or interrupt normal plant growth. Herbicides provide a convenient, economical, and effective way to help manage weeds. They allow fields to be planted with less tillage, allow earlier planting dates, and provide additional time to perform the other tasks that farm or personal life require. Due to reduced tillage, soil erosion has been reduced from about 3.5 billion tons in 1938 to one billion tons in 1997, thus reducing soil from entering waterways and decreasing the quality of the nation's surface water. Without herbicide use, no-till agriculture becomes impossible. However, herbicide use also carries risks that include environmental, ecological, and human health effects (Introduction to weeds and herbicide, 2007)

Herbicides are used mainly on plantation crops, such as rubber, oil palm, and paddy field the common ones are paraquat, glyphosate, 2,4-D (2,4-dichlorophenoxyacetic acid), diuron, MSMA (methylarsonic acid), picloram, and dalapon. Insecticides may also be required for disease control on rubber plantations, and molluscide and insecticide treatments are often used on rice cultivation. Pesticides are also employed on a wide range of other agricultural crops, such as vegetables, rice, fruit, and tobacco.

More recent studies of Malaysian rice-farming communities indicate that a large percentage of farmers develop symptoms associated with pesticide poisoning. In the intensely cultivated area of the Cameron Highlands, where pesticides are widely used, 95% of all poisoning cases are attributed to pesticides. In 1980, there were 17 cases of pesticide poisoning resulting in 4 deaths; in 1981, the number of cases increased to 20 with 11 deaths; and between January 1982 and April 1983, there were 11 cases and 4 deaths (Asna *et al.*1989).

2.3 Evaluation of dermal exposure by using fluorescent tracer dye

Other study by Lee and Chung (1985) and Lee (1987), using either Ciba-Geigy water-sensitive paper or fluorescent-tracer dye, carried out an extensive study on the potential contamination of various parts of a sprayer operator's body, using different types of applicators and under various crops or crop-spraying situations. They concluded that the extent of chemical contamination is affected by the type of applicators used, height and position of spray nozzle, and the speed and direction of the prevailing wind at the time of spraying. A conventional knapsack sprayer caused more extensive contamination than that resulting from a control droplet applicator (CDA).

Using the method of the Operator Protection Research Group (Ministry of Agriculture, Food, and Fisheries, UK) with lissamine green tracer dye, Tan *et al.* (1988) carried out a study to determine quantitatively the potential dermal exposure of spray operators. Operators using knapsack sprayers were exposed to 27.84 mL/ha, on average, compared with 31.78 mL/ha for those using CDA sprayers. Potential inhalation was 0.0010-0.0066 mL/ha for knapsack sprayers and 0.0001-0.0047 mL/ha for CDA sprayers. The front leg of the operator was most exposed, with exposure significantly higher for those using CDA sprayers (86%) than those operating knapsack sprayers (59%).

2.4 Skin effects

A number of herbicides have been associated with irritation of the skin, such as rashes, itching and general irritation. Sometimes symptoms may not manifest themselves until a considerable amount of time has passed since the exposure to the offending substance, especially when the contact was not directly with the herbicide but instead was with a sprayed plant---the more common situation. A 2004 article "Toxicology Review" implicated glyphosate, the active ingredient in the popular weed killer Roundup, in causing rashes along with a variety of other health problems.

Exposure to pesticides was found to be associated with a variety of common symptoms of chemical poisoning, ranging from mild effects such as skin irritation, nausea and vomiting, to even death. A study conducted in Malaysia reported that 43% of pesticide users experienced symptoms such as headache, drowsiness, vomiting, breathing difficulties, skin and eye irritation.

According to the study done by Pingali, 1994 in Philippine, Skin problems are commonly observed in farmers frequently exposed to pesticides. Mixing, handling, and applying pesticides could cause dermal contamination. The hands and forearms have the highest potential for pesticide contamination. Eczema, a chronic allergic dermatitis characterized by lichenification and fissuring, is a dermatologic health indicator of pesticide exposure. The skin appears thickened with accentuated markings.

The incidence of skin problems is positively related to the use of both insecticides and herbicides, although only the latter are significant. This is because most herbicides used in the Philippines are acetamides, and unprotected use of these chemicals is known to cause skin problems. Farmers at the sample average for age and nutritional status who do not apply any herbicides have a probability of 0.12 of having

skin problems. The probability of skin problems rises to 0.30 for farmers with one herbicide application and 0.50 for farmers with two applications.

Another studies by Ngowi *et al.*,(2007), Ntow *et al.*,(2006 and Alavanja *et al.*,(2004) in Tanzania reported that pesticide related health symptoms that were associated with pesticides use included skin problems and neurological system disturbances such as dizziness and headache.

Fuad *et al.*, (2012) also reported that in his study in Tanjung Karang itself shows that total of 51.5 percent of the farmers mentioned that 26% of the study population had itchiness and sore after or while spraying the pesticide, 13.7 % had rashes and hand skin peel off.

CHAPTER 3

METHODOLOGY

3.1 Study Location

This research has been conducted at the paddy field in Sawah Sempadan, Tanjung Karang, Selangor for the exposed group. While the data collection for unexposed group will be conducted among the farmers that have no exposures to pesticides.

3.2 Study Design

A Cross-sectional comparative study design was selected in this study to assess the effect of herbicide on the skin of the paddy farmers in Tanjung Karang, Selangor.

3.3 Sampling

3.3.1 Sample Population

The respondents of this study were consists of paddy farmers who involved in handling herbicides in their job tasks. While the comparative group were the ordinary farmers who work in the orchards.

3.3.2 Sample Frame

The sampling frame of this study will be the name lists of paddy farmers obtained from the Tanjung Karang Farmer's Organizations Officer. However, only those farmers who fulfill the inclusion criteria will be included in the study.

Inclusion criteria

- Paddy farmers with age group of 18- 64 years old.
- Paddy farmers who work >6 months in the paddy field.

3.3.3 Sample Study

The sample study consists of 97 workers from the paddy farmers who exposed to herbicides in their work tasks and 97farmers who is not involves with handling pesticides in their work activities.

Below is the sample size calculation by using Rubinson & Neutens formula, (1987).Their formula is used in this study as to compare among expose-control group. At the end of the calculation, the total will be doubled to get the total respondents for exposed and control group:-

$$N = (z/e)^2(p)(1-p)$$

Where:

N = sample size

z = standard score for significant level

p = estimation incident for population

For 95% significant level = 1.96, e = 0.1

Calculation for Exposed Group:

p = 0.30 based on study done by Pingali et al, 1994 (Pesticides and Philippine Rice Farmer Health: A Medical and Economic Analysis)

$$N = (1.96/0.10)^2(0.30)(0.70)$$

$$N = 80.6736$$

N = 81, minimum sample size for exposed group, also for the unexposed group.

To account any missing data during data collection process value are rounded up to 20%, which;

$$20\% \times 80.6736$$

$$=16.1347$$

$$=16$$

$$=16 + 81$$

$$=\underline{97 \text{ respondents}}$$

Thus the total sample size is 97 respondents for exposed and control group.

3.4 Instrumentation

3.4.1 Approval Letter

Consent letter were distributed among the listed respondent to get their consent to participate in this study.

3.4.2 Questionnaire

The questionnaire is one of the tools to get information from the workers. The set of questionnaires will be consists of personal information, socio-demographic, socio-economic, work activities, exposure history, year of work, and duration of work each day, usage of personal protective equipment (PPE), history of pesticides usage and health status of the workers, and also there will be the modified contact dermatitis questionnaire from Mc Gill University Health Care, (1999) were included. Since Bahasa Malaysia is our national language and the language is understood by most of citizens the questionnaire was modified in Malay version. Some diagrams and pictures were added into the second of questionnaire to make respondents more understands what researchers asked and achieved the research objectives.

3.4.3 Visual Scoring System With Fluorescent Tracers

3.4.3.1 Fluorescent tracer dye

Tinopal CBS-X [disodium 4, 4' -bis (2-sulfostyryl) biphenyl] was used as tracer in this study (260 mg/l). It is used because of

- Low cost
- Water solubility
- Does not cause skin sensitization (Bierman et al., 1998; Houghton et al., 1998)
- Reported to degrade in sunlight by 9.4% in 100 min (Barber and Parkin, 2003).
- Tinopal binds strongly to the skin and cannot be easily removed by rinsing or washing (Bierman et al., 1998).

3.4.3.2 Standard operating procedures

In the field, before the observation the tracer was placed into the tank of the mist blower by one of the researchers before the farmer poured the concentrated pesticide, which was not traced. Farmers applied the pesticide as usual. Immediately after finishing the application, fluorescent depositions were videotaped in the darkened foldaway room. At the start of the observation, farmers were asked to go inside a dark room that has been prepared in the hall. A hand held UV lamp (UVP, model UVSL-26P) without filter was used for illumination. Farmers were offered eye protection. The observation procedure inside the foldaway dark room has been described (Aragon et al., 2004).

3.4.4 Body Surface Segments

To evaluate the whole body surface, the body was divided into, (*refer Figure 3*);

- Face
- Neck
- Trunk
- Upper arms
- Forearms
- Legs
- Hands
- Feet

For ethical reasons, thighs remained covered and could not be considered for scoring.

This resulted in 27 body segments scored for all. (*Table 3.1*).

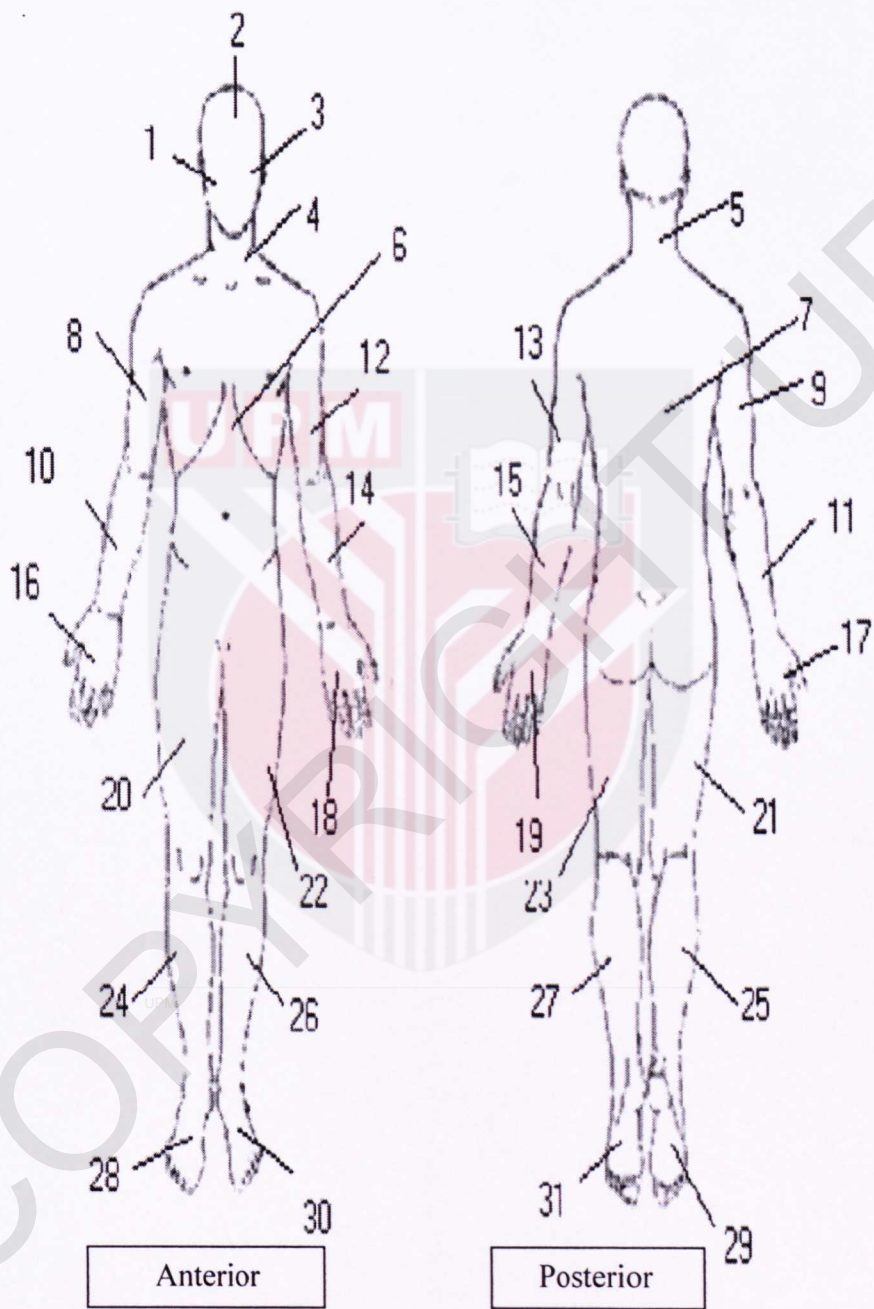


Figure 3.0: The 31 body segments distributed in the Anterior and Posterior of the total body area.

Table 3.1: Body Segment Define For Total Visual Score

| Body area | No. | Body segment | Body area | No. | Body segment |
|-----------|-----|--------------|-----------|-----|---------------|
| Face | 1 | Right | Hands | 16 | Right palm |
| | 2 | Front | | 17 | Right dorsal |
| | 3 | Left | | 18 | Left palm |
| Neck | 4 | Front | | 19 | Left dorsal |
| | 5 | Back | Thighs | 20 | Right front |
| Thorax | 6 | Front | | 21 | Right back |
| | 7 | Back | | 22 | Left front |
| Arm | 8 | Right front | | 23 | Left back |
| | 9 | Right back | Legs | 24 | Right front |
| Forearm | 10 | Right front | | 25 | Right back |
| | 11 | Right back | | 26 | Left front |
| Arm | 12 | Left front | | 27 | Left back |
| | 13 | Left back | Feet | 28 | Right dorsal |
| Forearm | 14 | Left front | | 29 | Right plantar |
| | 15 | Left back | | 30 | Left dorsal |
| | | | | 31 | Left plantar |

3.4.5 The scoring system

There are two scoring systems that have been used to evaluate the dermal exposure on the respondent, which the Visual Scoring System by using Exposure Evaluation Matrix (EEM) by Fenske, (1988) and Determinants of dermal Exposure Ranking Method (DERM) by Blanco, (2008).

i) Visual Scoring System

The Visual Scoring System is presented as a matrix in Table 2 below. The rows, Exposed Area denote the degree of extension of the fluorescence on each body part, while the column of the matrix shows the intensity of the fluorescent tracer. Each of these characteristics of exposure is represented as a scale of 5 possible scores. Exposed Area has been subdivided by percent: <20% of the body surface being exposed receives a score of "1", whereas exposure to >80% is scored as "5". Similarly, the Exposure Intensity scale represents a range of exposures from low to high. The values presented within the matrix represent all of the possible scores with the system, ranging from 1 to 25.

Table 3.2: The Exposure Evaluation Matrix (Fenske, 1988)

| Area exposed (%) | | | | | | |
|------------------|---|--------------------|----|----------|----|------|
| 80-100 | 5 | 5 | 10 | 15 | 20 | 25 |
| 60-80 | 4 | 4 | 8 | 12 | 16 | 20 |
| 40-60 | 3 | 3 | 6 | 9 | 2 | 20 |
| 20-40 | 2 | 2 | 4 | 6 | 8 | 10 |
| 0-20 | 1 | 1 | 2 | 3 | 4 | 5 |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Low | | Moderate | | High |
| | | Exposure Intensity | | | | |

Figure 3.1: Example of scoring contamination of the left palm



Source: Dermal exposure to pesticides in Nicaragua; A qualitative and quantitative approach (Aragon et al., 2005)

Figure 4 shows the contamination of hand and the score given, which the left palm of a farmer with fluorescent depositions. Three basic contamination patterns identified for the reading were splashes, mist and friction; for each type, categories of a low, moderate and high were developed (Aragon *et al.*, 2005)

ii) Determinants of dermal Exposure Ranking Method (DERM)

The Determinants of dermal Exposure Ranking Method (DERM) was developed to assess exposure to plant protection products under conditions of developing countries (Blanco *et al.*, 2008). This method is a combination of checklists and expert rating methods. Determinants are listed in a form, which is used to check their presence and to assess them using a simple algorithm based on two factors, the type of transport process (T value) and the area of body surface exposed (A value) (*refer to Figure 3.2*). In addition, the type of clothing worn during application is also included as a protection factor (C value). The type of transport process is evaluated following the conceptual model for dermal exposure proposed by Schneider *et al.* (Schneider *et al.*, 1999).

According to this model, the contaminant can reach the skin through emission (direct release from a source onto the skin or clothing), deposition (settlement of the contaminant onto the skin or clothing from the air) or transfer (transport from contaminated surfaces). Once the transport process is characterized, a score (1–5) is assigned, assuming that transfer processes lead to low exposure, deposition processes lead to a medium exposure and emission processes lead to high exposure. The area of the

body surface expected to be contaminated by a particular determinant is ranked from 1 to 5, representing percentage ranges of the total body surface as follows: 0–20, 21–40, 41–60% and so on. Figure 3 below describe the flow of the scheme of the DERM algorithms.

Step 1: To determine the factor T and A for each determinants

$$\text{Determinants (Det}_i\text{)} = \text{Transport (T}_i\text{)} \times \text{Area exposed (A}_i\text{)}$$

Transport process(T)

Area exposed(A)

| Categories | Example | Score |
|------------|---|-------|
| Transfer | From a piece of clothing or by touching a previously contaminated surface | 1 |
| | Touching a recently splashed/spilled surface | 3 |
| Deposition | Walking into the spray cloud, spraying against wind | 4 |
| Emission | Introducing hand into the tank, fixing nozzle with bare hand | 5 |

- 0-20% = 1
- 21-40% = 2
- 41-60% = 3
- 61-80% = 4
- 81-100% = 5

Step 2: To assess the clothing worn by the farmers (C)

| Piece of clothing | Exposure reduction |
|-------------------|--|
| Shirt | Long-sleeved=0-2 Short-sleeved=0.1 Old /overused=0.0 |
| Pants | Long=0.2 Short=0.1 Old/ overused=0.0 |
| Shoes | Yes=0.1 No=0.0 |

Step 3: To estimate the potential dermal exposure and DERM.

$$\text{Exposure} = \text{Sum}(\text{Det}_i)$$
$$\text{DERM} = C \times \text{Exposure}$$

Figure 3.2: The flow of the scheme of the DREM algorithm.

3.5 Data Analysis

All the data analysis will be analyze using the statistical analysis by performing SPSS 19.0 (Statistical Package for Social Science) and Microsoft Excel 2007 for Window Seven. Descriptive statistic including mean, median, and standard deviation will be run to know and to analyze the distribution of all variable include in this study.

Descriptive statistic will be used to analyse descriptive data including socio demographic of respondents, socio- economic, working experience, history of exposed to pesticides and usage of personal protective equipments (PPE) and some questions in the contact dermatitis questionnaire. The statistical analyses were run to get percentage, means, standard deviation, ranges, percentiles, maximum and minimum values.

The normality test in this study will be done by using Kolmogorov- Smirnov test where p value of Kolmogorov-Smirnov Test of greater than 0.05 would indicate a normal distribution data. If data not normally distributed, non- parametric test will be used to analyse data. For example, the first and second hypothesis the Mann Whitney U Test was used as the data was not normally distributed, and chi-square crosstab were used to determine the difference between two groups. For the last objectives, multiple linear regressions were used to determine the correlation and association between skin symptom and the selected variables among the exposed group.

will be used if the data is normally distributed and Kruskal- Wallis test will be used if the data not normally distributed.

3.5 Quality control.

Pre-test of questionnaire will be conducted for 10% of sample size before data collection process. The pre-test will be conducted among the staff of the University Putra Malaysia Farm .This procedure to ensure all questions that asked in the questionnaire was understandable by respondents and could be answer by the respondents. Pre-test can avoid questionnaire bias and would improve and strengthen the result.

3.7 Ethical Consideration

Before data collection, the permission to carry this study is request from board of Committee of Ethical, Faculty of Medicine and Health Sciences of University Putra Malaysia. The identity of the respondents including their personal information will be remained confidential and individual data was not going to be stated in any parts of the study or publication. After ethical considerations get approved by Ethic Board Community, Faculty of Medicine and Health Sciences the data collection has will be conducted.

- 1) The respondents will be given brief explanation about the whole of the study activities involved before the data collection carried out.
- 2) The respondents will be given brief explanation about the purpose of the visual scoring system and fluorescent tracers take place.

CHAPTER 4

RESULT

4.1 Study Location

This study was carried out in paddy field located in Kampung Sawah Sempadan, Selangor (*Figure 4.0*). It is a part of the Barat Laut Paddy Project within the north of Selangor state which is in the southeast part of Malaysia. Global Positioning System (GPS) coordinates for the area is 3.730467°N, 101.029567°E. The paddy soil is classified as Sedu Series (Typic Sulfaquepts) which is developed over brackish water deposits (Paramanathan, 2000). The selected area comprised of plots belonging to 54 farmers with a total hectare of 70 ha with an average lot size of 1.2 ha or less. Fertilizer applications are limited to the farmers' perception, or at best, based on general recommendations provided by agricultural agencies.

Paddy cultivation has become the identity of the community in the Tanjung Karang vicinity as rice is their main crop production. Tanjung Karang is the third largest paddy producer in Selangor after Kedah and Perak. It is a reality that the Malay community livelihood is still dependent on agriculture sources as their main source of income. This paddy field at Kampung Sawah Sempadan spans an area of approximately 2,300 hectares of Tanjung Karang sub district (Fuad *et al.*, 2012)

It has a population of 39,857 people and comprises of 90% Malays, 8% Chinese and the rest are Indians. The Chinese live in the urban area and involved in business or retailing. The Malays and Indians live in the rural areas performed agricultural activities, particularly rice cultivation. The areas have been selected on account of it is the third largest area of paddy field in Peninsular Malaysia, which is also known as 'the Rice Bowl of Selangor'. It covers 14,848 acres of rice field with 2,194 families of farmers and producing an average of 3.8 ton of rice per hectare per year (Aisyah *et al.*, 2010)

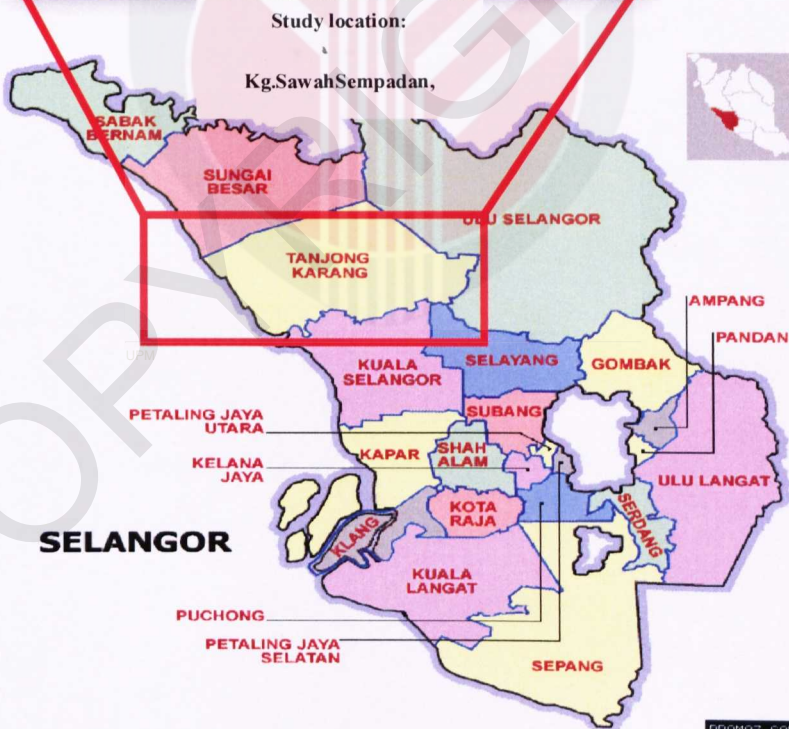
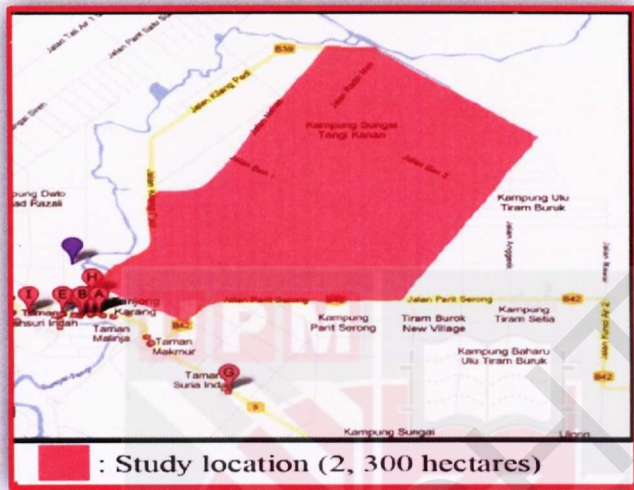


Figure 4.0: Map of study location

4.2 Process of Paddy Cultivation

From the Agriculture Department of Kuala Selangor, the paddy cultivation process was carried out by two times a year, with each cycle of paddy cultivation takes around 6 months to gain the final product. Paddy cultivation process includes several steps which are preparation of the soil, irrigate paddy block, planting the seed, fertilizing/pesticide control, and harvesting. The farmers started to use pesticides in the process of preparing the land on which herbicide was used to control the growth of weeds in the paddy field. In the process of irrigating the paddy block, they used pesticides which are herbicide again to control weeds and *padi angin* growth also raticide to control the rats' population at the paddy field. During the process of planting of rice seeds, there is no pesticides used, but in the process of fertilizing and pest control, which is after the rice seeds are completely sowed, there are many type of insecticide, herbicide and also molluscide in order to control the pests, hence to increase the productivity of rice (Figure 4.1). The type of insecticide that widely used at Tanjung Karang paddy field is Avisect and Chlorpyrifos, while for herbicide that they are commonly used are Paraquat, 2,4-D and Glyphosate. They also widely used molluscide to control the population of Golden Apple Snail also known as *siput gondang* in Malay word.

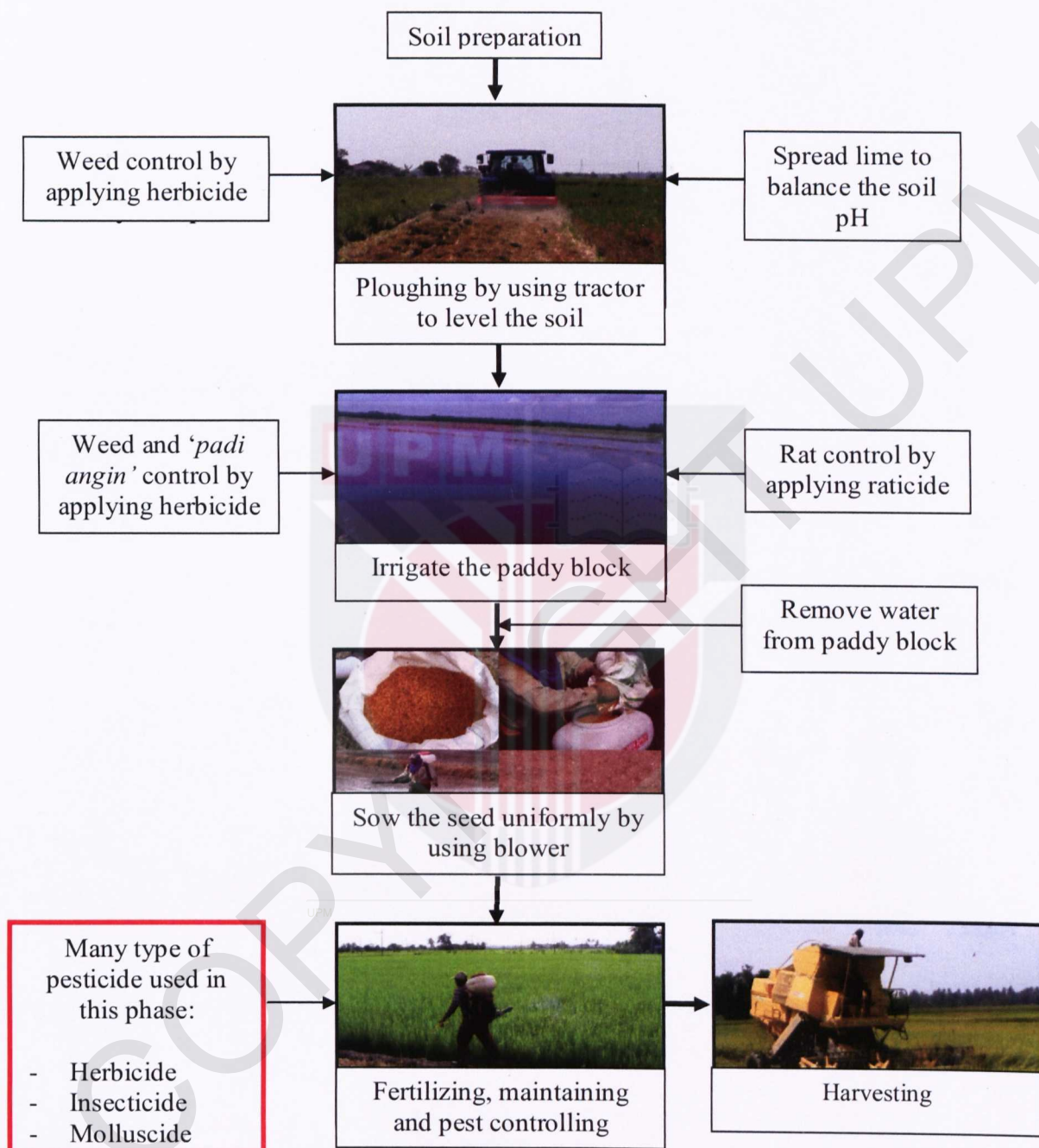


Figure 4.1: Process of Paddy Cultivation

4.3 Study Sample

This study was conducted to determine the skin exposure and dermal contamination when handling with pesticide among paddy farmers at Kampung Sawah Sempadan, Tanjung Karang, Selangor. Contaminations due to pesticide exposure through dermal route among paddy farmer were traced by using Fluorescent tracers. Pesticides are mostly used in their work activities during the spraying season and farmers were highly exposed to the pesticide such as herbicide and insecticide. This study was conducted on 75 paddy farmers who exposed to pesticide during mixing, loading and spraying activities; whereas control group was conducted among 30 farmers who have comparatively less exposure to pesticide.

4.3.1 Respondents' background

Background information on the exposed and control group was obtained through a self-administrated questionnaire in which socio-demography background information is collected, e.g. age ,monthly income, education years, working duration in years and in hours, as show in the Table 4.1 below. Table 4.1 showed that, through the independent t-test there is no significant different of socio- demographic background between exposed and control group.

Table 4.1: Sociodemographic characteristics of the respondents (n=103)

| Variable | Mean (SD) | | t | p |
|--------------------------|----------------|------------------|-------|-------|
| | Exposed (n=75) | Control (n=30) | | |
| Age (Year) | 41.36 (12.73) | 40.90(11.51) | 0.172 | 0.864 |
| Monthly income (RM) | 1282.53(492.1) | 1340.00 (703.73) | 0.011 | 0.991 |
| Education years | 10.20 (2.13) | 10.97 (1.07) | 0.198 | 0.864 |
| Working duration (years) | 16.72(13.70) | 13.97 (7.36) | 0.265 | 0.788 |
| Working duration (hours) | 4.73(1.27) | 4.50 (0.97) | 0.132 | 0.970 |

Independent t-test

4.3.2 Lifestyle of exposed and control group

Table 4.2 shows the lifestyle information between exposed and control group. Most of the respondents for exposed (65.3%) and control group (76.7%) were smokers and have an average of 10 years smoking habit. Nevertheless, 21% of respondents have claimed that they only smoke when they are in the field.

Table 4.2: Lifestyle of exposed and control group

| Variable | n (%) | | Mean (SD) | |
|--------------------------|----------------|----------------|----------------|----------------|
| | Exposed (n=75) | Control (n=30) | Exposed (n=75) | Control (n=30) |
| Smoking habit | 49 (65.3) | 23 (76.7) | | |
| Smoking exposure (years) | | | 11.56 (9.87) | 10.85 (8.42) |
| No. of cigarette | | | 8.84 (8.42) | 5.37 (3.50) |
| Smoke during work | 16 (21.3) | 4 (13.3) | | |
| Bathe before work | 70 (93.3) | 30 (100) | | |
| Bathe after work | 71 (94.7) | 29 (96.67) | | |
| Change clothes everyday | 75 (100) | 30 (100) | | |

4.3.3 Information on the types of pesticide used, working activities and equipments used among of farmers in paddy field

Table 4.3 shows the different type of pesticide used among respondents, most were insecticides (94.7%) followed by herbicide (89.3%) and molluscide (85.3%). While for the control group, 90% of the respondent used insecticide and herbicide and only 6.7% used molluscide for their crops. All the respondents for exposed and control group performed mixing and spraying of pesticide and 93.3% of exposed group and 92% of control group are actually involving in fertilizing activities at the same time.

The frequency of use of insecticide shows the highest prevalence for groups, i.e. 94.7% among exposed group and 90% among control group, followed by herbicide and molluscide. For the type of equipment, 94.7% of the exposed group used motorized mist blower compared to control group where they used manual knapsack sprayer (84%). This is because for exposed group, the paddy farmers need to apply the pesticide in the large area approximately 3 acres for a paddy farm compared to control group where they only involve in the spraying activities on a smaller area.

Table 4.3: Information of working activities of farmers

| Variables | Exposed (n=75) | Control (n=30) | X ² | p-value |
|-----------------------------------|-------------------|-------------------|----------------|-----------|
| Type of pesticides used | | | | |
| Insecticide | 71 (94.7) | 19 (63.3) | 17.18 | < 0.001** |
| Molluscide | 64 (85.3) | 6(20.0) | 41.16 | < 0.001** |
| Herbicides | 67 (89.3) | 11 (36.7) | 31.12 | < 0.001** |
| Type of activities | | | | |
| Mixing | 75 (100) | 2 (6.7) | 95.46 | < 0.001** |
| Spraying | 75 (100) | 4 (13.3) | 86.39 | < 0.001** |
| Fertilizing | 70 (93.3) | 23 (76.7) | 5.88 | 0.015* |
| Type of spraying equipment | | | | |
| Knapsack sprayer | 24(32.0) | 21(84.0) | 0.29 | 0.592 |
| Mist blower | 71(94.7) | 3 (12.0) | 61.09 | < 0.001** |
| Pressure sprayer | 4(5.3) | 18 (72.0) | 0.75 | 0.386 |

*p-value is significant at $p < 0.05$

**p-value is significant at $p < 0.01$

4.4 Prevalence of personal protective equipment (PPE) used among the farmers

Information of wearing personal protective equipment (PPE) among exposed and control group during their work activities are shown in the Table 4.3. Despite the high risk and frequency of exposure, farmers did not wear proper personal protection while working with pesticides.

Long sleeve and trousers (97.3%), were the most common protective equipment worn by the farmers, and practically, water-proof clothes (2.9%) are not used by the farmers during their work activities. Face masks which did not offer adequate protection over some chemicals were used by a number of respondents (68.6%). Hat/cap (81.9%), gloves (50.5%) and eye protector/ sun glasses (36.2%) were also used during pesticide handling in the field.

During interview, most of the farmers knew that PPE's advantages in protect them against direct exposure to pesticide, however due to hot and humid weather, they choose not to wear water-proof clothes or rubber gloves as they are not comfortable using the PPE. Boots and other types of PPE will make them feel uncomfortable to do the work as they have to carry the heavy mist blower on their back under the hot climate. Through the site observation, researcher reported that most of farmers improvised t-shirt as the mask while working. Statistic showed that there was a significant difference in rubber boots and mask between the two groups.

Figure 4.2 shows the common personal protective equipment (PPE) used by the respondents during the field observation.

Pictures;

- a) Respondent handled the pesticide by using barehanded
- b) Poor work practices and lack of appropriate PPE, such as gloves and boots
- c) Respondent did not wear boots
- d) Obviously, respondent handled the pesticide with barehanded and wore short sleeves and pants
- e) Wore almost complete PPE but not appropriate mask, as he only used t-shirt as the mask
- f) respondent handled pesticide with barehanded without gloves

Table 4.4: Prevalence of personal protective equipment (PPE) used among the farmers

| Variables | Exposed (n=75) | Control (n=30) | Overall (N=105) | X ² | p |
|--------------------|-------------------|-------------------|--------------------|----------------|-----------|
| Mask | 66 (88.0) | 6 (20.0) | 72(68.6) | 45.98 | < 0.001** |
| Gloves | 36 (45.0) | 17 (56.7) | 53(50.5) | 0.64 | 0.422 |
| Trousers | 74 (98.7) | 30(100) | 103(98.1) | 0.46 | 0.498 |
| Hat / cap | 61 (81.3) | 25 (83.3) | 86(81.9) | 0.06 | 0.810 |
| Long sleeves | 74 (98.7) | 29 (96.7) | 103(98.1) | 0.46 | 0.498 |
| Rubber boots | 52 (69.3) | 30 (100) | 82(78.1) | 11.78 | 0.001** |
| Eye protector | 31(41.3) | 7 (23.3) | 38(36.2) | 3.01 | 0.083 |
| Waterproof clothes | 3 (54.0) | 0(100) | 3(2.9) | 3.70 | 0.157 |

Chi-square test

**p-value is significant at $p < 0.05$*

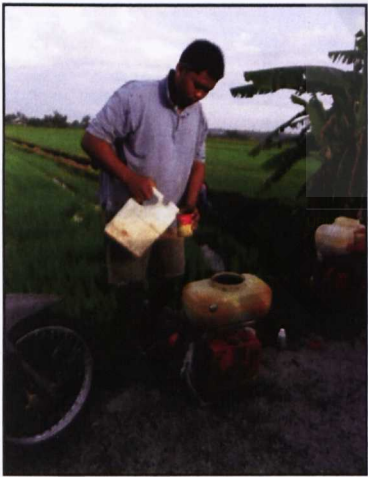
***p-value is significant at $p < 0.01$*



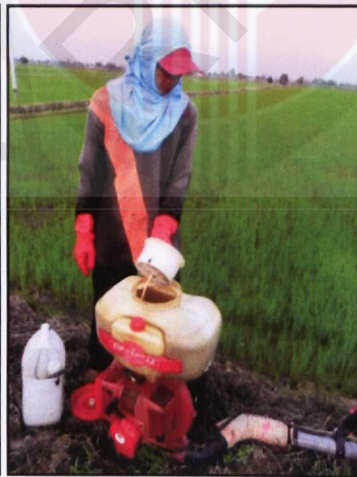
a)

b)

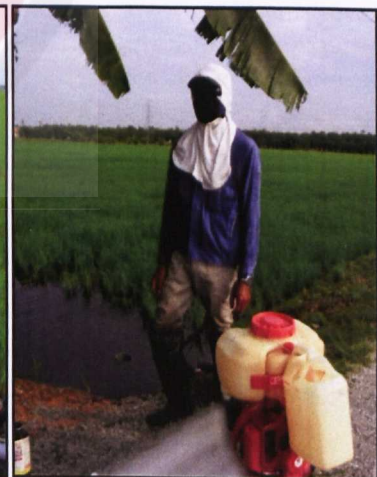
c)



d)



e)



f)

Figure 4.2: The clothes and personal protective equipment used by the respondents

4.5 Prevalence of body part exposed to pesticide during work activities

Prevalence of body part exposed to pesticide during work activities have been determined by using fluorescent tracers dye as shown as the anterior (Figure 4.2) and posterior view (Figure 4.3)

Most of the pesticide exposure among the exposed group can be seen on their right finger (36.9%), back of the thorax (35.2%), right palm and left finger (25.4%)

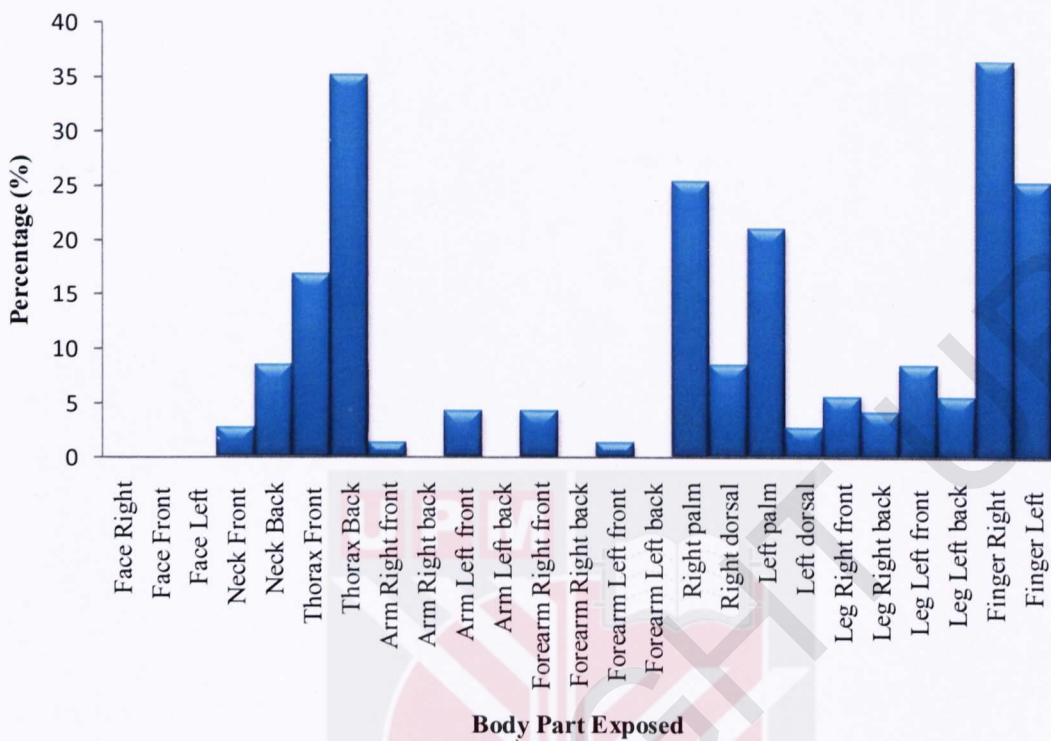


Figure 4.3: Bodies'parts exposed to the pesticide during the work activities.

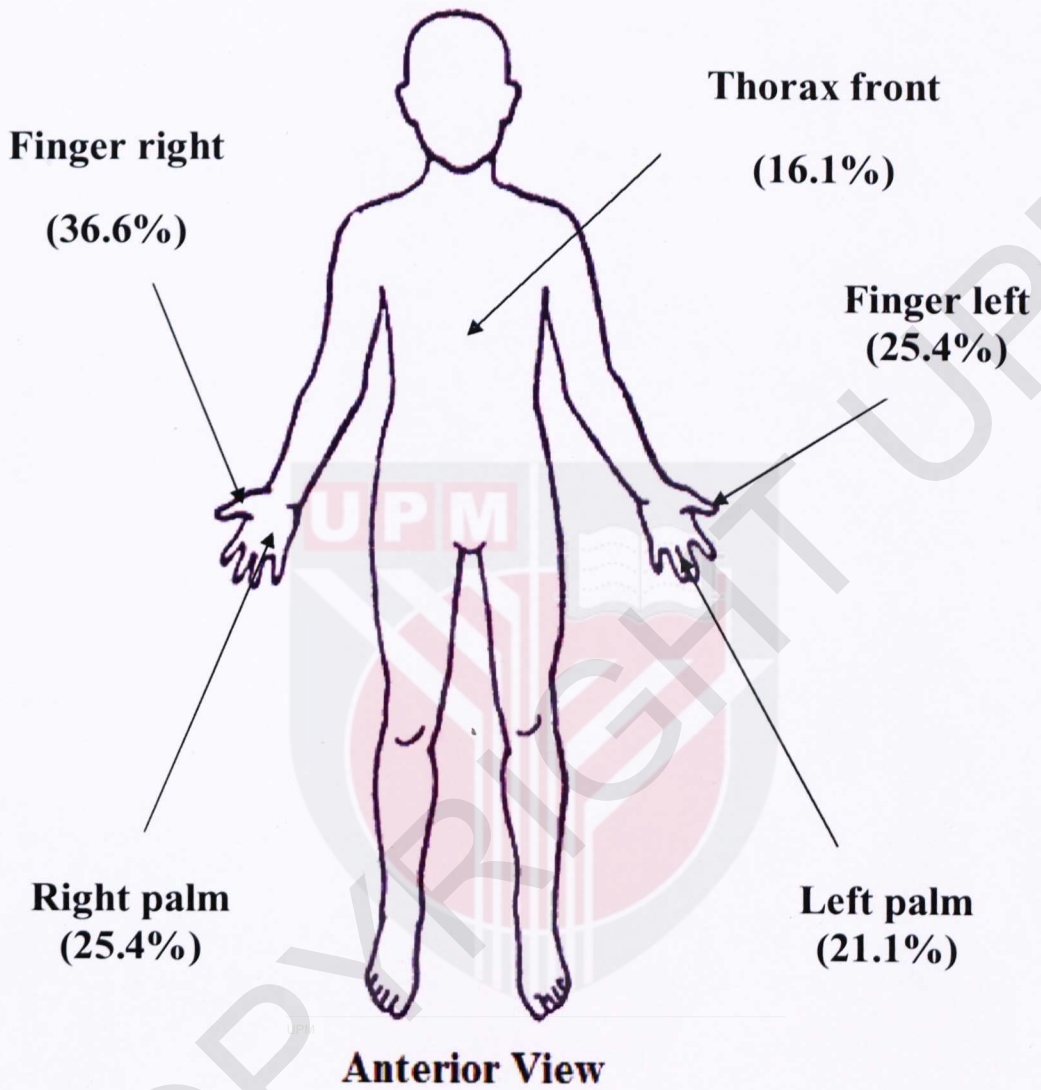
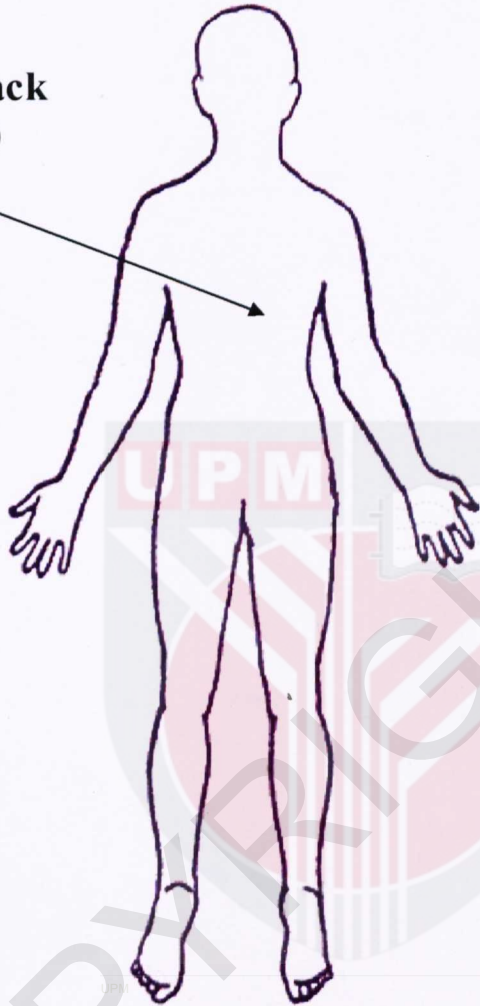


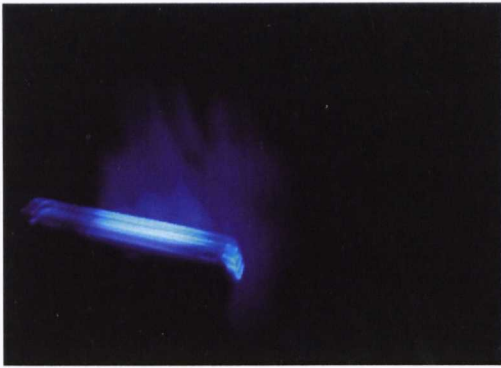
Figure 4.4: The most exposed body part from the anterior view of the respondent

**Thorax Back
(35.2%)**



Posterior View

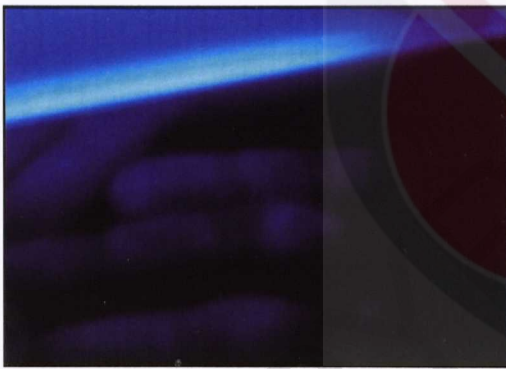
Figure 4.5: The most exposed body part from the posterior view of the respondent



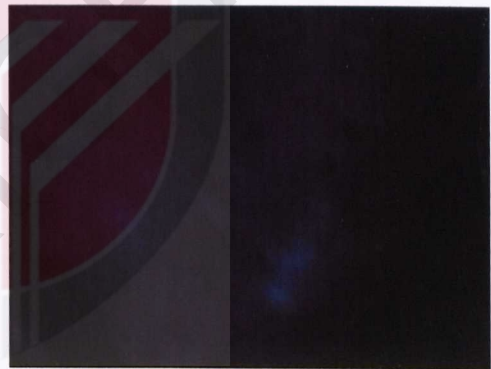
A. On the front of thorax



B. On the back of thorax



C. On the right finger



D. On the right palm

Figure 4.6: The picture of pesticide dyed with fluorescent tracer, observed by using UV light in the dark room.

4.6 Skin symptoms among respondents.

Face to face interview by using self-reported questionnaire among both groups of respondents' showed that 68% of exposed group and 93.3% of control group do not have pre-existing skin symptoms while handling pesticides, and only 32% of exposed group and 6.7% of control group reported the skin symptoms after exposures to pesticides. Overall, there was a significant association between overall skin symptoms with exposure as seen in Table 4.5.

Table 4.5: Skin symptoms reported by respondents (N=103)

| | Exposed (n=75) | Control (n=30) | Overall (n=103) | X ² | p |
|---------------|-------------------|-------------------|-----------------|----------------|--------|
| Skin symptoms | | n (%) | | | |
| Yes | 24(32) | 2 (6.7) | 26(24.3) | 16.185 | <0.001 |
| No | 51(68) | 28 (93.3) | 79(76.7) | | |

4.7 Prevalence of skin symptoms among the respondents (n=103)

The skin symptoms related to pesticide exposure were included in the questionnaire. Table 4.6 shows the prevalence of self-reported skin symptoms among exposed and control group. The prevalence of skin symptoms included itchiness (20%), redness (10.5%), rash (9%), pain (1.9%), crusty and scaled (1%) and blister (4.0%) which reported among both of groups commonly occurred or appeared during and after the acute exposure to pesticide. There was a significant difference of itchiness and skin redness between the two groups ($p < 0.05$).

Table 4.6: Prevalence of skin symptoms among the respondents (n=103)

| | Exposed (n=75) | Control (n=30) | Overall (N=103) | X ² | p |
|---------------|-------------------|-------------------|--------------------|----------------|---------|
| Skin symptoms | n (%) | n (%) | N (%) | | |
| Itchy | 19(25.3) | 2(6.7) | 21(20.0) | 4.667 | 0.031* |
| Rash | 10(13.3) | 1(3.3) | 11(10.5) | 2.285 | 0.131 |
| Redness | 10(13.3) | 0 | 10(9.5) | 4.421 | 0.035 * |
| Blister | 3(4.0) | 0 | 3(2.9) | 1.235 | 0.266 |
| Scaling | 1(1.3) | 0 | 1(1.0) | 0.404 | 0.525 |
| Crusty | 1(1.3) | 0 | 1(1.0) | 0.404 | 0.525 |
| Pain | 2(2.7) | 0 | 2(1.9) | 0.816 | 0.366 |

Chi-square test

* *Significant at $p < 0.05$*

4.8 Period of skin symptom appears after the exposures. (N=75)

Table 4.7 shows that the period of time of skin symptoms appear after the respondent handle pesticide during their work activities. Through the interview, most of the skin symptoms appears after the acute exposure to the pesticide. Sixty percent of the exposed group and 90% of control group said that the symptoms appear immediately after they handle the pesticide. In other words, farmers generally perceived that pesticide gave only short-term effects to their skin and they were not detrimental. Independent t-test showed that there is a significant difference between the two groups of respondents on the time of immediately after exposed to pesticides.

Table 4.7 Period of skin symptom appears after the exposures. (N=75)

| Time | Exposed(n=75) | Control(n=30) | t | p |
|---------------------------|---------------|---------------|--------|--------|
| | Yes (%) | Yes (%) | | |
| Immediately after exposed | 37(49.3) | 18(60.0) | 3.098 | 0.003* |
| 1-2 hours after exposed | 10(13.3) | 2(6.7) | 0.838 | 0.404 |
| 2-4 hours after exposed | 4(5.3) | 3(10.0) | -1.107 | 0.271 |
| 12 hours after exposed | 3(4.0) | 1(3.3) | -1.128 | 0.134 |

4.9 Association between dermal exposures with skin symptoms among the exposed group

The associations between dermal exposures with skin symptoms among the exposed group are analyzed by using the Chi square test. In this study, dermal exposure is quantified by applying two dermal scores, which is Exposure Evaluation Matrix (EEM) and Determinants of dermal Exposure Ranking Method (DERM). EEM is a matrix which used to quantify the dermal exposure by considering i) area of exposure and ii) exposure intensity; whereas DERM is a ranking system which quantify the dermal exposure by assessing different factor, such as i) the transportation of pesticide, ii) Area of body surface and iii) Type of clothing protection.

On the other hand, to determine the association between DERM score with the existence of skin symptoms complaints among study population, the same test Chi square test was used. In this study, DERM score is categorized into low (0-3) and high (4-6) based on the scoring distribution. The null hypothesis was rejected as ($p > 0.05$), thus there was no significant association between DERM score with all the skin symptoms among paddy farmer (Table 4.8)

In order to determine the association between EEM score with the existence of skin symptoms complaints among study population, Fisher's exact test was used to analyze the association between the two variables. In this study, EEM score is categorized into low (1-3) and high (4-6) based on the scoring distribution. The result is summarized in Table 4.6. Since the p value is >0.05 , it shows the normal distribution, do not reject null hypothesis, and thus no significant association between EEM score with all the skin symptoms among paddy farmer (Table 4.9).

Overall, there is no significant association between skin symptoms with dermal scores such as EEM and DERM methods among the exposed groups.

Table 4.8 Association between dermal score (DERM score) with skin symptoms among the exposed group (n=75)

| Variable | DERM score | | p-value* |
|-------------------------|-------------|-------------|----------|
| | High | Low | |
| Skin symptoms | | | |
| Itchiness, n (%) | | | |
| Yes | 5.8 (34.8) | 14.3 (21.1) | 0.256 |
| No | 17.3 (65.2) | 42.8(78.9) | |
| Rashes, n (%) | | | |
| Yes | 2.9(13.0) | 7.1(12.3) | 0.926 |
| No | 20.1(87.0) | 49.9(87.7) | |
| Redness, n (%) | | | |
| Yes | 2.9(4.3) | 7.1(15.8) | 0.267 |
| No | 20.1(95.7) | 49.9(84.2) | |
| Blister, n (%) | | | |
| Yes | 0.9(4.3) | 2.1(3.5) | 0.858 |
| No | 22.1(95.7) | 54.9 (96.5) | |
| Pain, n (%) | | | |
| Yes | 0.3(0) | 0.7(1.9) | 0.523 |
| No | 22.7(100) | 56.3(98.2) | |

*skin symptoms of scaling and crusty are not reported among respondents

Table 4.9 Association between dermal score (EEM score) with skin symptoms among the exposed group (n=75)

| Variable | EEM score | | p-value* |
|-------------------------|-------------|------------|----------|
| | High | Low | |
| Skin symptoms | | | |
| Itchiness, n (%) | | | |
| Yes | 18.8(72.0) | 13.8(23.6) | 0.676 |
| No | 6.30(28.0) | 41.1(72.7) | |
| Rashes, n (%) | | | |
| Yes | 3.10(12.0) | 6.90(12.7) | 0.927 |
| No | 21.9(88.0) | 48.1(87.3) | |
| Redness, n (%) | | | |
| Yes | 3.10 (8.0) | 6.90(14.5) | 0.494 |
| No | 21.9(92.0) | 84.1(85.5) | |
| Blister, n (%) | | | |
| Yes | 0.9(4.0) | 2.1(3.6) | 0.937 |
| No | 24.1(96.0) | 52.9(96.4) | |
| Pain, n (%) | | | |
| Yes | 0.3(0) | 0.7(1.80) | 0.497 |
| No | 24.7(100.0) | 54.3(98.2) | |

*skin symptoms of scaling and crusty are not reported among respondents

4.10 Selected variables that influenced skin symptoms among exposed group

The last objective in this study was to determine the selected variables that significantly influenced the prevalence of skin symptoms among the exposed group. Multiple Linear Regression (stepwise method) analysis is used to identify independent variable which significantly influenced the skin symptoms. Among the 7 skin symptoms that have been analyzed, only itchiness, rashes and redness shows significant relationship between the predictor factors of skin symptoms' development due to pesticide exposure. The rest of skin symptoms such as blister, scaling, crusty and pain were not included in the test as the result shows there is no significant relationship between these symptoms and the selected variables.

4.10.1 The factors related with itchiness due to herbicide exposure among paddy farmers

The dependent variable is itchiness, while the predictor factors as independent variable include, Personal hygiene (Bathe before and after work), duration of work (years, days, and hours), type of spray equipments (Mist blower Knapsack sprayer), type of pesticide formulation (liquid and powder) ,Personal Protective Equipment (PPE), working time (morning and evening), and type of pesticide use (insecticide, molluscide

and herbicide) and Model I below forms a mathematical model for the prediction of itchiness.

Model I

$$\text{Itchiness} = 1.159 + 0.235(\text{Powder}) + 0.098(\text{working duration per hours})$$

$$R^2 = 0.262 \text{ (26\% of existing predictor factors fit the modal above)}$$

From the model above, we noticed that one of type of pesticide formulation which is powder and working duration per hours showed significant correlation and positive relationship with itchiness. Table 4.9.1 showed the another selected factors related with itchiness among the paddy farmers

Table 4.9: Selected variables influenced itchiness among exposed group (n=75)

| Independent Variable | T | p | F | p |
|--------------------------------------|--------|----------|--------|----------|
| Personal hygiene | | | | |
| Bathe before work | 1.040 | 0.302 | | |
| Bathe after work | 1.487 | 0.141 | | |
| Working duration | | | | |
| Years | 0.135 | 0.893 | | |
| Days | -1.146 | 0.255 | | |
| Hours | 4.379 | <0.001** | | |
| Type of pesticides | | | | |
| Insecticides | -0.676 | 0.501 | | |
| Molluscide | 1.770 | 0.081 | | |
| Herbicides | 0.663 | 0.509 | | |
| PPE Total | -0.542 | 0.589 | | |
| Spray time | | | | |
| Morning | -0.143 | 0.887 | | |
| Evening | -0.425 | 0.672 | | |
| Type of Spray machine | | | | |
| Knapsack sprayer | 0.598 | 0.552 | | |
| Mist blower | 0.078 | 0.938 | 12.787 | <0.001** |
| Type of pesticide formulation | | | | |
| Liquid | 0.431 | 0.668 | | |
| Powder | 2.297 | 0.025* | | |

*p-value is significant at $p < 0.05$

**p-value is significant at $p < 0.01$

4.10.2 The selected factors related with rashes due to herbicide exposure among paddy farmers

Equation II below forms a mathematical model for the prediction of selected variables influence the rashes .Table 4.9.2 below showed the factors related with rashes to herbicides among the paddy farmers.

Model II

$$\text{Rashes} = 2.072 + 0.049 (\text{working duration per hours}) - 0.323(\text{insecticide})$$

$$R^2 = 0.187 \text{ (19\% of existing predictor factors fit the modal above)}$$

From the model, we noticed working duration per hours showed positive relationship and insecticide showed negative relationship with skin rashes. Table 4.9.2 shows another selected factors related with rashes to herbicides among the paddy farmers.

Table 4.10: Selected variables influenced rashes among exposed group (n=75)

| Independent Variable | T | p | F | p |
|-------------------------------|--------|---------|------|----------|
| Personal hygiene | | | | |
| Bathe before work | 0.559 | 0.578 | | |
| Bathe after work | 0.938 | 0.351 | | |
| Working duration | | | | |
| Years | 0.228 | 0.820 | | |
| Days | -1.513 | 0.135 | | |
| Hours | 3.287 | 0.002** | | |
| Type of pesticides | | | | |
| Insecticides | -1.995 | 0.050** | | |
| Molluscide | 0.974 | 0.333 | 8.30 | <0.001** |
| Herbicides | -0.670 | 0.505 | | |
| PPE Total | -1.001 | 0.320 | | |
| Spray time | | | | |
| Morning | -1.329 | 0.188 | | |
| Evening | -0.038 | 0.970 | | |
| Type of Spray machine | | | | |
| Knapsack sprayer | 0.801 | 0.426 | | |
| Mist blower | -0.755 | 0.453 | | |
| Type of pesticide formulation | | | | |
| Liquid | 0.179 | 0.859 | | |
| Powder | 1.238 | 0.220 | | |

*p-value is significant at $p < 0.05$

**p-value is significant at $p < 0.01$

4.10.3 The selected variables elated with redness due to herbicide exposure among paddy farmers

Model III below forms a mathematical model for the prediction of selected variables influence the redness. Table 4.9.3 shows the factors related with redness to herbicides among the paddy farmers.

Model III

$$\text{Redness} = 2.027 + 0.043(\text{working duration per hours}) - 0.051(\text{working duration per day})$$

$$R^2=0.154 \text{ (15\% of existing predictor factors fit the modal above)}$$

From the equation, we noticed that working duration per hours showed positive relationship while working duration per days showed negative relationship with skin redness.

Table 4.11: Selected variables influenced redness among exposed group (n=75)

| Independent Variable | T | p | F | p |
|--------------------------------------|--------|--------|-------|--------|
| Personal hygiene | | | | |
| Bathe before work | 0.442 | 0.660 | | |
| Bathe after work | 0.917 | 0.362 | | |
| Working duration | | | | |
| Years | -0.068 | 0.946 | | |
| Days | -2.188 | 0.032 | | |
| Hours | 2.859 | 0.006* | | |
| Type of pesticides | | | | |
| Insecticides | 1.128 | 0.263 | 6.559 | 0.002* |
| Molluscide | -0.158 | 0.875 | | |
| Herbicides | 0.662 | 0.510 | | |
| PPE Total | 1.302 | 0.197 | | |
| Spray time | | | | |
| Morning | -0.102 | 0.919 | | |
| Evening | 1.218 | 0.227 | | |
| Type of Spray machine | | | | |
| Knapsack sprayer | 0.990 | 0.326 | | |
| Mist blower | 0.446 | 0.657 | | |
| Type of pesticide formulation | | | | |
| Liquid | 0.023 | 0.982 | | |
| Powder | 1.336 | 0.186 | | |

*p-value is significant at $p < 0.05$

**p-value is significant at $p < 0.01$

4.10.4 The selected variables related with total of the skin symptoms due to herbicide exposure among paddy farmers

Model VI below forms a mathematical model for the prediction of selected variables influence all the skin symptoms .Table 4.8.8 below showed another factors that related with total of skin symptoms among the paddy farmers.

Equation VI

$$\text{Total skin symptoms} = 0.968 + 0.155(\text{working duration per days}) - 0.529(\text{powder}) - 0.215(\text{working duration per hours})$$

$$R^2 = 0.300 \text{ (30\% of existing predictor factors fit the modal above)}$$

From the equation, we noticed that only working duration per days showed positive relationship while powder formulation of pesticide and working duration per hours showed negative relationship with total of skin symptoms among the exposed group.

Table 4.12: Selected variables influenced the total of skin symptoms among exposed group (n=75)

| Independent Variable | T | p | F | p |
|-------------------------------|--------|--------|-------|--------|
| Personal hygiene | | | | |
| Bathe before work | 0.442 | 0.660 | | |
| Bathe after work | 0.917 | 0.362 | | |
| Working duration | | | | |
| Years | -0.068 | 0.946 | | |
| Days | -2.188 | 0.032* | | |
| Hours | 2.859 | 0.006 | | |
| Type of pesticides | | | | |
| Insecticides | 1.128 | 0.263 | 6.559 | 0.002* |
| Molluscide | -0.158 | 0.875 | | |
| Herbicides | 0.662 | 0.510 | | |
| PPE Total | 1.302 | 0.197 | | |
| Spray time | | | | |
| Morning | -0.102 | 0.919 | | |
| Evening | 1.218 | 0.227 | | |
| Type of Spray machine | | | | |
| Knapsack sprayer | 0.990 | 0.326 | | |
| Mist blower | 0.446 | 0.657 | | |
| Type of pesticide formulation | | | | |
| Liquid | 0.023 | 0.982 | | |
| Powder | 1.336 | 0.186 | | |

*p-value is significant at $p < 0.05$

**p-value is significant at $p < 0.01$

Overall, multiple linear regression shows that, there are only average of 20-40% of predictor factors fit the skin symptoms. Rashes shows the most significant different ($p < 0.05$) to the existing predictor factors. Besides, lifestyle factors, for instances, smoking habit, and smoking frequency (number of cigarette) and hygiene practices (bathing before and after worked, also daily change clothes) among farmers show a significant negative relationship with itchiness and rashes complaint.



CHAPTER 5

DISCUSSION, RECOMMENDATION AND CONCLUSION

5.0 Discussion

5.1 Subject and Methods

In this study, 75 paddy farmers were chosen as study population due to their highly exposure to pesticide during their work activities compared to the farmers who have comparatively less exposure to the pesticide during their work activities. The continual market demand to maintain high level of rice output for consumption has resulted in increased use of pesticides on rice fields in Malaysia, thus paddy farmer is among one of the susceptible group who highly exposed to the pesticide (Pingali et al., 1997).

Pesticides are highly used by the paddy farmers in order to combat the pest, thus can increase the paddy production. The use of pesticides has been an important contributor to improved rice productivity. Hence, chemical insecticides are widely adopted as primary agents of pest control.

5.2 Fluorescent Tracer kit and Visual Scoring Systems

Dermal exposures are known to be the most relevant in the occupational setting (Sartorelli, 2002). Methods to assess dermal have been largely improved in the last decade. Dermal exposure to chemicals was evaluated as early as 1880 (Fenske, 2000). The development of methods to assess dermal exposure has considerably increased since the last decade (Fenske, 2000)

Fluorescent tracers were first employed in occupational health more than 20 years ago as a qualitative tool for a dermal exposure study of orchardists (Franklin *et al.*, 1981). Since then, different types of fluorescent tracers have been used to estimate dermal exposure (Fenske *et al.*, 1986; Roff, 1994; Bierman *et al.*, 1998), evaluate performance of protective devices (Fenske, 1988a; Fenske *et al.*, 2002), for educational

purposes (Houghton *et al.*, 1998; Foss *et al.*, 2002), and to demonstrate the non-uniformity of dermal exposure (Fenske, 1990). The fluorescent compounds have also been examined quantitatively with video-imaging to estimate exposure of the entire body surface (Fenske *et al.*, 1986; Fenske, 1988b). The principle is that a fluorescent tracer is added to a hazardous solution and traced afterwards by means of a UV lamp. This approach is helpful in determining the body parts which are highly contaminated with pesticide during pesticide handling throughout their work activities.

In this study, dermal contamination due to pesticides exposures among paddy farmers in Tanjung Karang was measured by using Florescent Tracer Kit. In order to quantify the exposures, two types of scores were applied which Exposure Evaluation Matrix (EEM) is also known as Visual Scoring System and Determinants of dermal Exposure Ranking Method (DERM). EEM is a matrix or system which used to quantify the dermal exposure by considering of extent and intensity of florescent tracer images on each body segment of the exposed paddy farmers whereas DERM is a ranking system which quantify the dermal exposure by assessing different factor, such as i) the transportation of pesticide, ii) Area of body surface and iii) Type of clothing protection.

Based on the scoring distribution, DERM score was categorized into low (0-3) and high (4-6). As a result, there was no association between DERM scores with the

existence of skin symptoms complaints among study population (Table 4.8). The null hypothesis was rejected as ($p > 0.05$). The same method was applied to determine the association the EEM Score with the existence of skin symptoms complaints among study population. EEM score was categorized into low (1-3) and high (4-6) based on the scoring distribution. The result was summarized in Table 4.9. Since the p value is > 0.05 , it shows the normal distribution, do not reject null hypothesis, and thus no significant association between EEM score with all the skin symptoms among paddy farmer

Overall, there is no significant association between skin symptoms with dermal scores such as EEM and DERM methods among the exposed groups.

5.3 Prevalence of body part exposed to the pesticide during the work activities.

According to Blanco (2008), for the extent of the florescent tracer images, the most common florescent depositions were those caused by contact with contaminated surfaces such as smear, through splashes and mist, and combination of pattern were also observed. This situation also can be observed during the paddy farmers handled the pesticides and during spraying activities. Pesticide dyed with florescent tracers mostly

observed on the hands part as the many of the farmers tend to handle the pesticide by using bare handed without wearing gloves. Blanco (2008) also reported that deposition were most frequently observed on the front and back hands which is > 87% of the farmers, the front of the left forearm (75%), and the back of the trunk (75%). Depositions were less frequently observed on the front of the right upper arm (19%) and the back of the right thigh (19%). The findings are similar to this study where high prevalence of pesticide exposure can be observed at the right finger (36.6%) and the back of trunk (35.2%) of the farmers. Most of the paddy farmers used right hand as their dominant hand while working, that is why pesticide exposure are mostly found on the right finger of the paddy farmers. The pesticide contaminant can be observed mostly at the back of the trunk due to the spillage of the pesticide from the mist blower that the respondent used to carry during the spraying activities and sometimes not tightly closed. When walking in the paddy field, sometimes they were unable to balance their body as the ground of paddy field were very soft and muddy. Then, the possibilities of pesticide spill on the farmers' body were high.

This trend of body part exposure is similar to the activity-scenario happened in previous study by Aragon (2005) who stated that indirect dermal contact occurred more frequently than direct contact both in relation to the pesticide concentrate and the spray solution. Throughout field observation, the most common indirect contact were touching

surfaces contaminated with pesticides such as the backpack, pesticide containers, measuring devices, leaves and pieces of plastics and cloth.

5.3 Prevalence of personal protective equipment (PPE) used by respondents

Result of the survey on PPE worn showed that rubber/ water-proof clothes and gloves were not widely been used by respondent, in accordance to this, most of them said that by wearing boots and other PPE made them uneasy to do the work as they have to carry the heavy mist blower on their back under the hot weather. Through site observation, some of respondents used bare hand when handling with pesticide, wear short sleeves shirt and were bare footed

Rozita et al., (2011) reported that 99.0% of the studied respondents wore trousers (99.0%), long sleeves (98.0%), rubber boots/jungle boots (92.0%) as their cloth while working similar to this study where among the exposed group, about 97.3% of the respondents wore long sleeve and trousers, 74.7% of them wore boots. VanWendel, *et al.*, (2005) and Fred (1999) also concluded that dermal exposures depend on the appropriate use of personal protective equipment (PPE), whereas Fenske (1988) has

evaluated that the face and hands contamination of farmers were the most common body parts prone to contamination. However, when wearing protective equipment, farmers usually did not wear appropriate protective clothing, and extensive skin contamination can occur in multiple body parts (Aragon, 2005).

Guo *et al.*, (1996) reported that most farmers reported regular use of hat (99.2%), boots (96.7%), and mask (91.0%), but not many of them wore gloves (36.1%), raincoat (7.4%), and goggles (3.3%). This resulted in frequent skin contact with pesticide especially on the hands and face.

5.4 Prevalence of skin symptoms among the respondents.

According to Spiewak (2001), Pesticides help to achieve better quality and quantity of crops; however, they are capable of causing occupational diseases in farmers. Skin is the most exposed organ while spraying the pesticide on fields. Farmers are also exposed to pesticides while mixing, loading the pesticide as well as while cleaning the equipment and disposing of empty containers. Skin problems were commonly observed in farmers frequently exposed to pesticides. Other activities associated with exposure are sowing pesticide preserved seeds, weeding and harvesting previously sprayed crops. In

the case of contaminating skin with pesticides in field, most farmers wash the skin and change their clothing only after having finished their work – the prolonged exposure increases risk of unwanted effects of these substances, both irritating, allergising and carcinogenic.

Mixing, handling, and applying pesticide could cause dermal contamination (Pingali *et al.*, 1994). The skin symptoms reported by this study's population were: itchiness, rashes, redness, blister, scaling, crusty and pain have also been previously well documented. Table 4.6 summarized the prevalence of skin symptoms. The complaints of skin itchiness, rashes and redness are common symptoms appeared after acute exposure to pesticides among the farmers.

In accordance to this finding, several previous studies related to the skin symptoms among paddy farmers showed that the result of prevalence of skin symptoms are similar to this study where itchiness and pain (26 %), had rashes and hand skin peel off (13.7 %) by Fuad *et al.*, (2012), Rafee *et al.*, (2011) reported that 76.7% of the respondents had skin itchiness, 10% of the respondents by Huang (2001) and 87.3 % of the respondents claimed that they had skin problems (Oluwafemi *et al.*, 2009). Another study in China by Zhang *et al.*, (2011) reported that the most frequent acute pesticide

poisoning is skin related symptoms (11.6%) which is 106 out of 910 respondent followed by nervous symptoms (10.7%) among the respondents.

Table 4.5.3 shows farmers who have ever experienced of skin symptoms perceived that these symptoms were acute and only cause short term health effect which would not cause any deleterious effect. Nevertheless, a study by Forget, (1991) showed that, the symptoms of acute poisoning can vary from skin irritation to a complex systemic illness resulting in death.

5.5 Association between dermal exposures with skin symptoms among the exposed group

In order to quantify the dermal contamination score in occupational setting, Fenske (1988) introduced a scoring system of EEM. This matrix is adoptable based on visual observation of fluorescent images combining with the use of scoring matrix.

In a previous study by Blanco et al., (2008), a low cost and easy to use method for assessment of dermal exposure to pesticides in subsistence farmers by using of determinants of dermal exposure was described. The method, called the determinants of

dermal exposure ranking method (DERM), is a combination of checklists and expert rating assessment. Thus, determinants are listed in a form, which is used to check their presence and to assess them using a simple algorithm based on two factors, the type of transport process and the area of body surface exposed. In addition, the type of clothing worn during applications is included as a protection factor. DERM allowed identification of the determinants that had the highest effect on exposure and the farmers with the highest exposure.

Based on the result, there was no significant association of EEM and DERM scores and skin symptoms among the exposed group, this is due to the prevalence of skin symptoms among the exposed group is very low (36%). In addition, the instrument used in this study, the Fluorescent Tracer Kit was not sensitive enough to determine the dermal exposures among the exposed group.

5.6 Selected variables influence skin symptoms among exposed group

Occupational dermal exposure is one of the significant routes of exposures which are always neglected by the community (Semple, 2004). Lack of appropriate information on the safe handling of pesticides and knowledge of possible health outcome contributed to the pesticide exposure and related illnesses.

According to Semple (2004), more attention was given to dermal exposure to pesticides as compared to respiratory exposure. The risk of uptake of chemical through dermal contact has been demonstrated to be larger and more difficult to control than respiratory uptake. Existing predictors factors (socio-demographic and lifestyle) showed relatively low percentage ($R=26\%$) to fit to the skin symptoms. This might due to the reasons as shown by Rafee (et al., 2010) who stated that the most possible effect which affect dermal exposure were the type of personal protective equipment (PPE) use and the spraying equipment. Socio-demographic and lifestyle play less important factors in developing skin-related symptoms due to pesticide exposure.

Nevertheless, multiple regression analysis showed that, proper hygiene practices have significant inverse relationship with rashes on farmers. In other words, personal

hygiene daily is suggested to reduce the incidence of rashes prevalence among farmers. Besides, smoking habit and smoking frequency also showed inverse relationship with itchiness and rashes. During face-to-face interview, farmers have mentioned that smoking immediately after pesticide spraying helped to reduce tiredness and stress, which at the same time, reduce the pain sensation of itchiness and rashes due to pesticide exposure. However, further study is needed to justify whether smoking is part of the contributing factors for occupational-related skin symptoms.

5.7 Recommendation

- The farmers should practice good personal hygiene such as washing their hands before consuming food and drink
- To take bath after handling pesticide and change working clothes every day
- Always use appropriate PPE such as coverall, mask, glove and goggle during work activities in order to minimize the dermal exposure to pesticide during work.
- Enhance the awareness on the effects of pesticide to the health among the farmers

5.8 Conclusion

Study showed that there was high prevalence of dermal contamination of pesticide at hands, fingers and back of trunk among the exposed group. However, the acute effect of occupational-related skin symptoms was not prominent among paddy farmers. Since there was no significant association between skin symptoms and dermal score, these new approaches of dermal quantification seemed not effective and sensitive enough in determining the exposure and skin symptoms. Recommendations would include to assess the dermal herbicide exposure with fluorescent tracer by modified visual scoring system (Aurora, *et al.*, 2005) or toolkit for thorough dermal risk assessment (OPPL *et al.*, 2003) for future study. Nevertheless, since dermal contamination to pesticide is reported in this study, further study is recommended to determine the chronic effect of pesticide exposure on the skin histological level.

References

- Arago'n A, Blanco L, Funez A et al. (2005). Assessment of dermal pesticide exposure with fluorescent tracer: a modification of a visual scoring system for developing countries. *Annual Occupational Hygiene*; 50, 75–83.
- Arago'n A, Blanco L, Lo'pez L et al. (2004). Reliability of a visual scoring system with fluorescent tracers to assess dermal pesticide exposure. *Annual Occupational Hygiene*; 48, 601–6.
- Asna B.O, Balasubramaniam, A., Rabirah, A.(1989). Survey on the use of pesticides among non IPC farmers in Tanjung Karang. Unpublished.
- Van Wandel Joode. (2005). Risk Assessment in the Work Environment a collaborative centre between TNO Quality of Life and IRAS. *Central American Institute for Studies on Toxic Substances (IRET)*, National University, Heredia, Costa Rica
- Bierman EPB, Brouwer DH, Van Hemmen JJ. (1998). Implementation and evaluation of the fluorescent tracer technique in greenhouse exposure studies. *Annual Occupational Hygiene*; 42, 467–75.
- Blanco LE, Arago'n A, Lundberg I et al. (2005). Determinants of dermal exposure among Nicaraguan subsistence farmers during pesticide applications with backpack sprayers. *Annual Occupational Hygiene*; 49, 17–24.
- Bouman B.A.M., Tuong T.P. (2000). Field water management to save water and increase its productivity in irrigated lowland rice. *Agricultural Water Management*. Soil and Water Sciences Division, International Rice Research Institute, P.O. Box 3127, Makati Central Post Office, 1271 Makati City, Philippines
- Chester G. (1993). Evaluation of agricultural worker exposure to, and absorption of pesticides. *Annual Occupational Hygiene*. 37(5), 509-23.
- Chester, G. Woollen, B.H.(1981). Studies on the occupational exposure of Malaysian plantation workers to paraquat. *British Journal of Industrial Medicine*, 38, 23-33.
- Durham WF, Wolfe HR. (1962) .Measurement of the Exposure of Workers to Pesticides. *Bulletin of the World Health Organization*, 29,279-281.

- European Commission Health & Consumer Protection Directorate. (2006). *General Guidance Document on Dermal Absorption*. Retrived 11 October 20011.
- Fenske RA, Leffingwell JT, Spear RC. (1985). Evaluation of Fluorescent Tracer Methodology for Dermal Exposure Assessment. *American Industrial Hygiene Association Journal* .Honeycutt RC, Zweig G, Ragsdale NN.
- Fenske RA, Leffingwell JT, Spear RC (1986a) A Video Imaging Technique for Assessing Dermal Exposure -Instrument Design and Testing. *American Industrial Hygiene Association Journal*, 47,764-770.
- Fenske RA, Wong SM, Leffingwell JT, Spear RC (1986b). A Video Imaging Technique for Assessing Dermal Exposure- II. Fluorescent Tracer Testing. *American Industrial Hygiene Association Journal*, 47:771-775.735
- Fenske RA. (1993). Dermal exposure assessment techniques. *Annual Occupational Hygiene*. 37(6):687-706.
- Fuad, M.J. Mohd; Junaidi, A.B.; Habibah, A.; Hamzah, J.; Toriman, M.E.; Lyndon, N.; Er, A.C.; Selvad. (2012, January 1). The impact of pesticides on paddy farmers and ecosystem. *The Free Library*. Retrieved May 02, 2012
- Guo Y L, Wang B J, Lee C C, Wang J D. (1996) Prevalence of dermatoses and skin sensitization associated with use of pesticides in fruit farmers of southern Taiwan. *Occupational Environment Medicine*; 53(6), 427-431.
- Herbicide Health Effect* (2011), Article reviewed by Jessica Lyons Last updated on: Jun 15, 2011
- <http://www.biomedcentral.com/1471-2458/11/429> (3 June 2011)
- <http://www.epa.gov/pesticides/about/> Retrieved 9 October 2011
- <http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/MalaysiaAgriculture.html> Retrieved 28 April 2012
- Huang Jun, YU Gang, Qian Yi. (1990). The problems of persistent organic pollutants in China and Jeyaratnam J: Acute pesticide poisoning: a major global health problem. *World Health Stat Q*, 43(3):139-144.
- Jeyaratnam, J. et al. (1987). Survey of acute pesticide poisoning among agricultural workers in four Asian countries. *Bulletin of the World Health Organization*, 60: 615-619

- Jusoh Mamat, M. Anas, A.N. Heong, K.L. Chan, C.W. Nor, N.M. Ho, N.K. Zaiton, A.S. Fauzi, A. (1987). Features of lever operated knapsack sprayers considered important by Muda rice farmers in deciding which sprayer to buy. In Proceedings of the international conference on pesticides in tropical agriculture, 23-25 September 1987, Kuala Lumpur, Malaysia. *Malaysian Plant Protection Society*, Kuala Lumpur, Malaysia.
- Karim SMR, Azmi M, Ismail BS (2005). Weed problems and their management in rice fields in Malaysia: An overview. *Weed Biology Management*. 4: 177-186.
- Koh D, Jeyaratnam. (1996). Pesticides hazards in developing countries. *Science Total Environment*, 188.S78-85.
- Lee, S.A.; Chung, G.F.(1985). Safety aspects of LV, VLV, ULV and CDA application. In Teoh, C.H., Ea, Recent developments in pesticide application technology: proceedings of the workshop, 21 January 1985, Serdang, Malaysia. *Malaysian Plant Protection Society*, Kuala Lumpur, Malaysia. Pp.46-66.
- Litchfield MH (2005): Estimates of acute pesticide poisoning in agricultural workers in less developed countries. *Toxicology Review*, 24(4):271-278.
- London L, Bailie R. (2001), Challenges for improving surveillance for pesticide poisoning: policy implications for developing countries. *International Journal Epidemiology* 30(3):564-570.
- Matsushita T, Nomura S, Wakatsuki T. (1980). *Epidemiology of contact dermatitis from pesticides in Japan*. *Contact Dermatitis*, 6, 255-259
- Mc Gill University Health Centre (1999). *Contact dermatitis questionnaire*, Retrieved from http://www.truetest.ca/PDFs/CD_questionnaire.pdf
- Mohd Rafee B. Baharuddin, Ismail B. Sahid, Mohamad Azhar B. Mohd. Noor, Norela Sulaiman & Fadzil Othman (2011): Pesticide risk assessment: A study on inhalation and dermal exposure to 2, 4-D and paraquat among Malaysian paddy farmers, *Journal of Environmental Science and Health*, Part B, 46:7, 600-607
- Nashriyah, M. Zawahil, A.N. Zaifah, A.K. Misman, S.; Ismail, B.S. (2004). In *A Survey of Pesticide Usage in the Muda Rice Agroecosystem Between 2001–2003*; Proceedings of the MINT R&D Seminar 2004, Dewan Tun Ismail, Bangi, Selangor, July 12–15,; MINT: Bangi, 351–358.

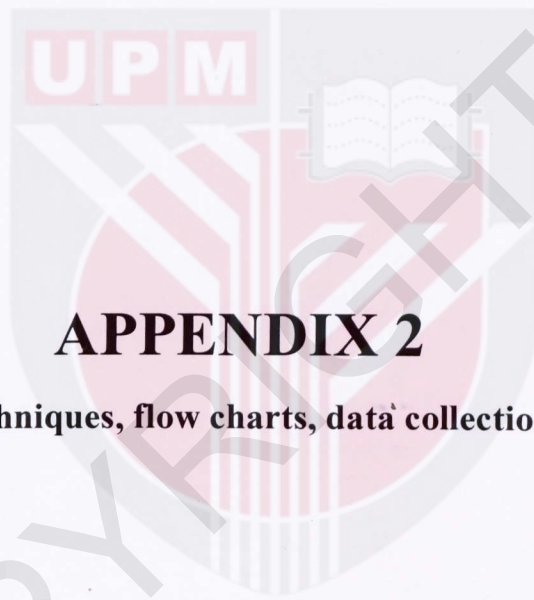
- National Poison Control and Information Service (2003), *Organophosphates poisoning*, Retrieved from <http://www.wpro.who.int/hse/pages/organophosphate.html>
- National Rural Health Care Association (1986). *The occupational health of migrant and seasonal farmworkers: Report summary*. Kansas City, MO
- Ness SA. (1994). *Surface and dermal monitoring for toxic exposures*. New York: Van Nostrand Reinhold.
- Ngowi H A, Mkupasi E M, Lekule F P, Willingham III A L and Thamsborg S M (2011). Impact of farmer education on their knowledge, attitudes, and practices in southern Tanzania: a case for *Taenia solium* control. *Livestock Research for Rural Development*. Volume 23, Article #2.
- Ntow, W. J. (2005): Pesticide residues in Volta Lake, Ghana. *Lakes & Reservoirs: Research and Management*.10,243–248.
- Oluwafemi Oluwole & Robert A. Cheke. (2009): *Health and environmental impacts of Pesticide Poisoning* Page 6 -81, Retrieved 7 October 2011.
- Prabhu L. Pingali, Cynthia B. Marquez, Florencia G. Palis. (1994). Pesticides and Philippine Rice Farmer Health: A Medical and Economic Analysis. *American Journal of Agricultural Economics*, Vol. 76, No. 3 (Aug., 1994), pp. 587-592
- Rozita Hod, Azimatun Noor Aizuddin, Shamsul Azhar Shah, Mohd Rohaizat Hassan, Nazarudin Safian and Mohd Hasni Jaafar. (2011). Chlorpyrifos Blood Level and Exposure Symptoms among Paddy Farmers in Sabak Bernam, Malaysia. *International Journal of Public Health Research Vol 1*, No 1 2011, pp (1-6)
- Sanborn MD, Cole D, Abelsohn A, Weir E (2001): *Identifying and managing adverse environmental health effects of pesticides*. *CAMJ* 166:1431
- Sanborn M., D. Cole, K. Kerr, C. Vakil, L.H. Sanin and K. Basil, (2004). *Systematic review of pesticides human health effects*. The Ontario, College of Family Physicians. <http://www.ocfp.on.ca/local/files/Communications/Current%20Issues>.
- Schneider T, Vermeulen R, Brouwer DH et al. (1999) Conceptual model for assessment of dermal exposure. *Occupational Environment Medicine*; 56: 765–73
- Schneider, T.; Cherrie, J.W.;Kromhout. (2000).H. Dermal exposure assessment. *Annals Occupational Hygiene*. 44, 493–499.

- Semple SE, Dick F, Cherrie JW. (2004) Exposure assessment for a population-based case-control study combining a job-exposure matrix with interview data. *Scand Journal Work Environment Health*; 30: 241–8.
- Spiewak R; Pesticides as a cause of occupational skin diseases in farmers. (2001). *Annual Agriculture Environmental Medicine*. 8, 1–5
- Stanley, A.G.; Richard, P.P. (2005) *Sittig's Handbook of Pesticides and Agricultural Chemicals*; William Andrew Publishing: Norwich, UK,. Their research countermeasures. *Environmental Protection*, 2001.11:3-6 (in Chinese)
- WHO. 2004. *The WHO recommended classification of pesticides by hazard and guidelines to classification: 2004*. World Health Organization. ISBN 92 4 154663 from http://www.who.int/ipcs/publications/pesticides_hazard/en/
- Wrubel, R.P.; Gressel, Z. (1994). *Are herbicide mixtures useful for delaying the rapid evaluation of resistance? A case study*. *Weed Technology*., 8 : 635- 648
- Zhang et al. (2011). Work-related pesticide poisoning among farmers in two villages of Southern China: a cross-sectional survey *Bio Medicine Centre Public Health* 2011, 11:429



APPENDIX 1

Gantt chart (The planning of study by month)

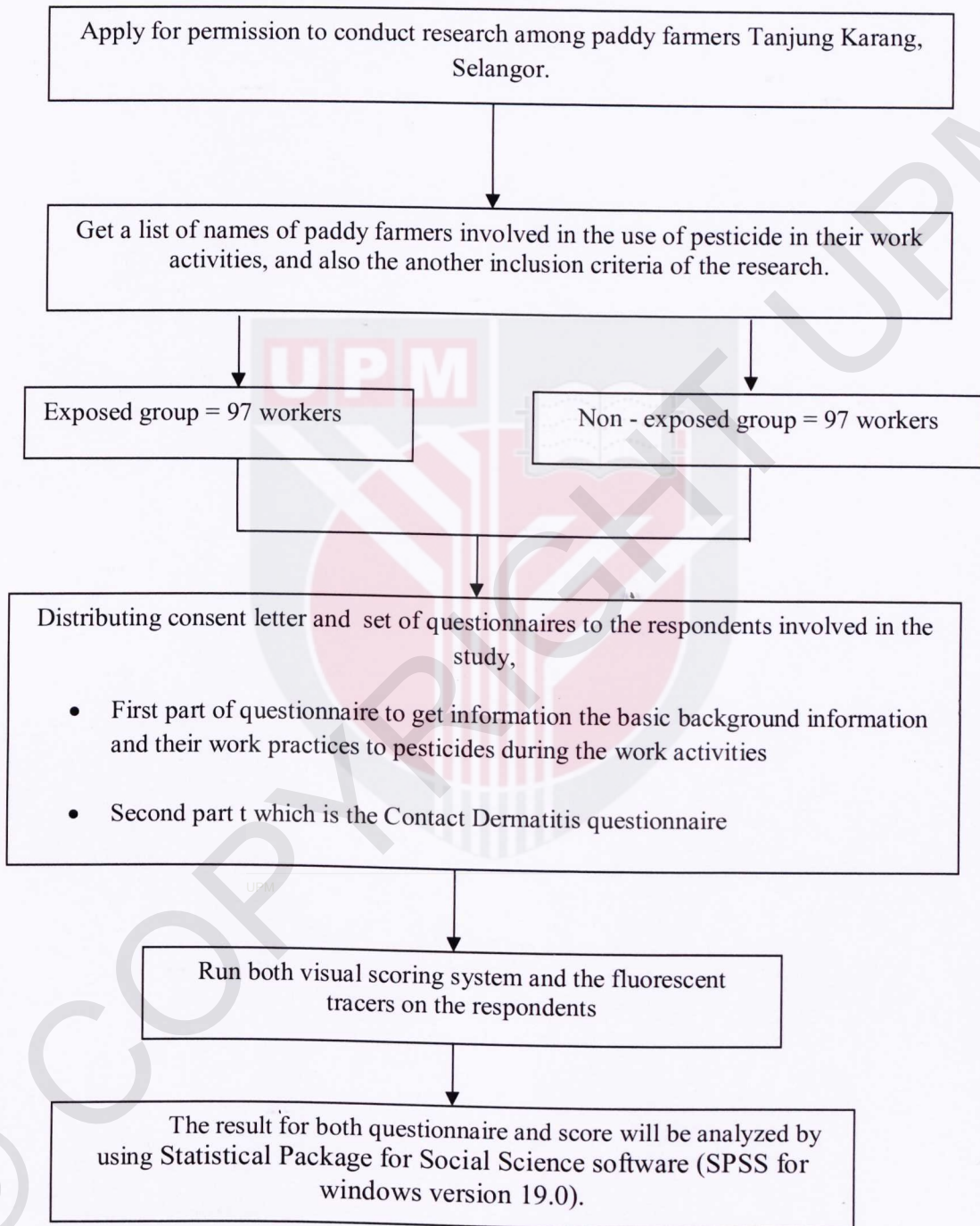


APPENDIX 2

Measurement techniques, flow charts, data collection and analysis

© COPY

UPM



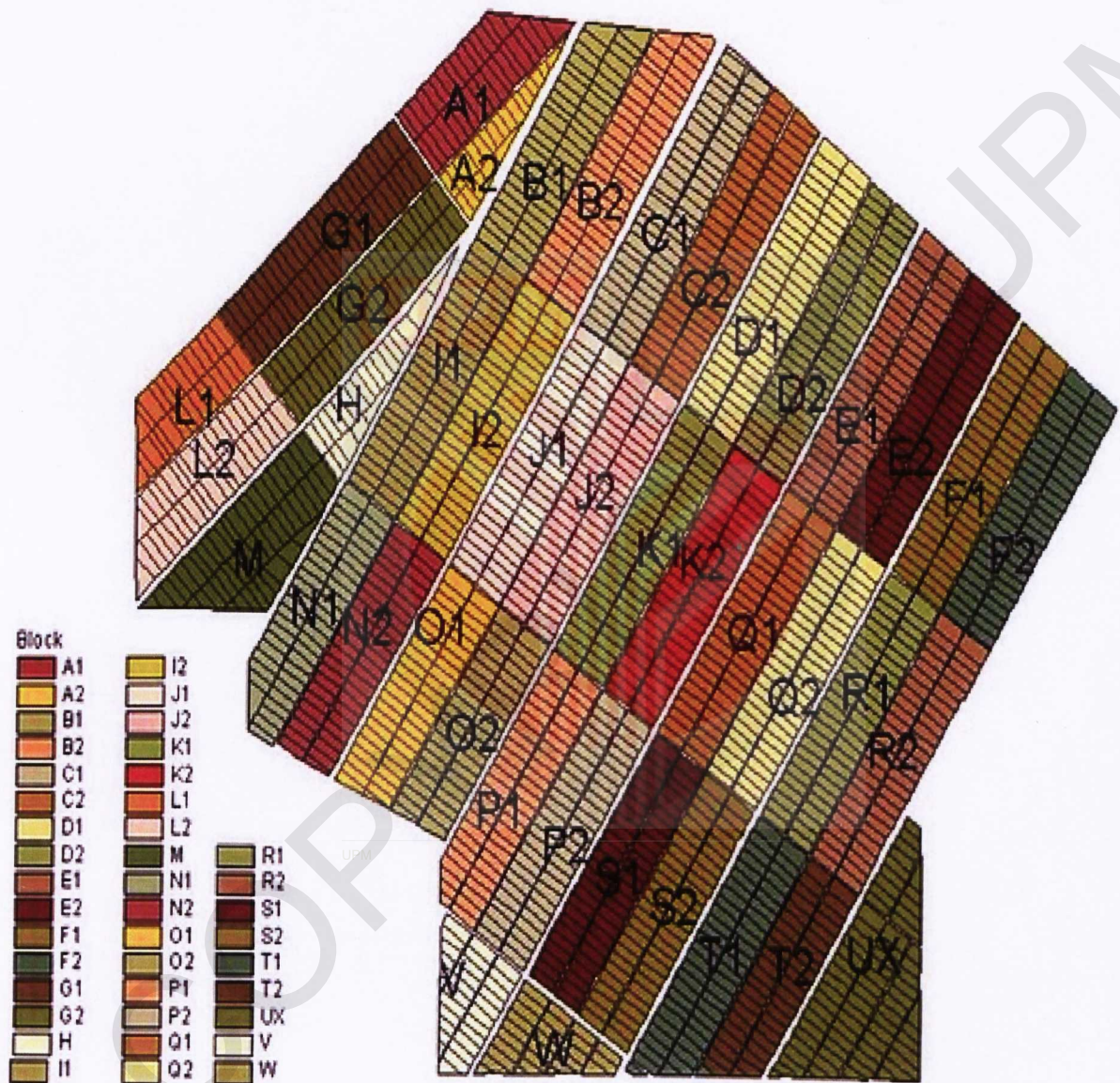
The image features a large, semi-transparent watermark of the Universiti Pertanian Malaysia (UPM) logo in the background. The logo is a shield-shaped emblem with a red and white color scheme. At the top left of the shield, the letters 'UPM' are written in white on a red rectangular background. To the right of the letters is a stylized white book icon. Below the book, there are several vertical white stripes of varying heights. The entire shield is set against a light grey background.

UPM

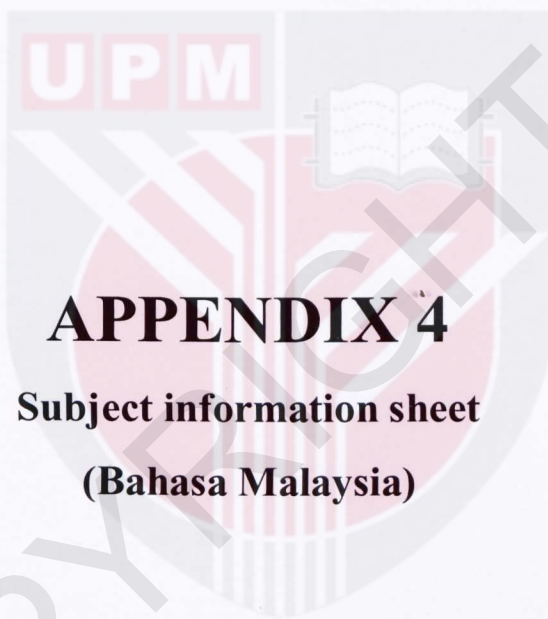
APPENDIX 3

Map of Kampung Sawah Sempadan(Block)

BLOCK IN SAWAH SEMPADAN



Map of Kampung Sawah Sempadan (block)



APPENDIX 4

Subject information sheet

(Bahasa Malaysia)

© COPY

UPM

LAMPIRAN MAKLUMAT RESPONDEN

Sila baca maklumat berikut dengan teliti, sila bertanya untuk membincangkan apa-apa soalan yang anda ada dengan penyelidik anda.

TAJUK KAJIAN

Pendedahan racun rumpai dan simptom kulit di kalangan pesawah padi di Tanjung Karang, Selangor

PENGENALAN

Kajian ini adalah tentang kesan penggunaan racun rumpai terhadap kulit pesawah padi. Racun yang biasa digunakan adalah paraquat / glifosat yang digunakan untuk membunuh rumpai. Ia digunakan secara meluas dalam bidang pertanian di sawah padi, sayur-sayuran ladang dan ladang tembakau. Terdapat 3 cara pendedahan dimana racun boleh memasuki tubuh manusia, iaitu melalui bernafas udara yang tercemar dengan racun rumpai, apabila makan atau minum makanan air yang tercemar dengan racun rumpai dan juga hubungan secara langsung melalui sentuhan kulit. Akibat pendedahan berlebihan dalam tempoh masa yang tertentu, ia boleh memberi kesan kepada keadaan kulit, dan simptom biasanya muncul adalah kemerahan, lepuh, gatal, bersisik dan merekah.

APA YANG ANDA AKAN MEMPUNYAI LAKUKAN?

Anda telah dipilih untuk menjadi salah satu daripada responden dalam kajian ini. Anda hanya perlu menandatangani borang peserta responden selepas membaca dan memahami huraian ini. Borang peserta mesti dikembalikan kepada penyelidik sebelum menjalankan apa-apa ujian. Selepas itu, anda akan mengikuti satu siri ujian akan dijalankan oleh penyelidik. Hanya ikut arahan yang diberikan oleh pengkaji.

YANG TIDAK PERLU ENTER KAJIAN?

Antara yang tidak dibenarkan untuk mengambil bahagian dalam kajian ini adalah kanak-kanak, wanita hamil, anak-anak muda di bawah umur 18 tahun, pekerja yang tidak mempunyai pengalaman bekerja sekurang-kurangnya 6 bulan di tempat kerja sekarang dan warga tua yang berusia 60 tahun di atas.

**APA AKAN FAEDAH KAJIAN:
(A) KEPADA ANDA?**

Keputusan kajian ini akan digunakan untuk penambahbaikan dan pengetahuan mengenai pengendalian keselamatan herbisid untuk masa depan dan penting untuk memakai Peralatan Perlindungan Peribadi betul. Keputusan juga akan menyediakan maklumat hasil atau implikasi kesihatan dari pendedahan kepada racun herba tersebut, responden akan menjadi kulit visual demonstrated the pencemaran disebabkan pendedahan herbisid betul-betul selepas herbisid permohonan od. Responden juga akan mendapatkan nasihat dan cadangan untuk penambahbaikan pada masa akan datang.

B) PENGKAJI?

Hasil kajian ini akan membantu penyelidik dalam mengumpul bukti kesan kesihatan apabila terdedah kepada racun herba. Kaji selidik itu juga akan membantu penyelidik dalam mencari penyelesaian kepada masalah pendedahan pekerja kepada herbisid dan juga boleh membantu penyelidik dalam mempromosikan kesihatan pekerjaan untuk masa depan. Maklumat kajian ini akan digunakan bagi merangka polisi dan pelaksanaan program untuk meningkatkan status kesihatan generasi akan datang. Di samping itu, kajian ini akan membantu penyelidik dalam menyelesaikan tugas sebagai pelajar tahun akhir.

ADAKAH TERDAPAT SEBARANG RISIKO?

Kajian ini tidak akan timbul sebarang risiko kemalangan, jangkitan, kecederaan, dan sebagainya. Semua proses penyelidikan akan dijalankan di kawasan yang selamat. Ujian juga akan dijalankan mengikut peraturan dan undang-undang.

APAKAH KELEMAHAN KAJIAN?

Kelemahan kajian ini adalah ujian mengambil masa kira-kira 30 hingga 45 minit setiap orang dan responden perlu menjalani ujian ini di dalam bilik gelap untuk melihat pencemaran kulit dengan menggunakan cahaya UltraViolet.

ADAKAH MAKLUMAT DAN IDENTITI SAYA AKAN KEKAL SULIT?

Semua maklumat mengenai responden telah dijamin rahsia dan sulit. Tiada maklumat individu dari semua aspek akan dibincangkan.

SIAPA YANG PERLU SAYA HUBUNGI JIKA SAYA ADA SOALAN TAMBAHAN SEMASA PROSES PENYELIDIKAN?

Sebarang masalah atau soalan semasa kajian ini boleh diajukan kepada penyelidik, Raihanah Bt Chokeli untuk berjumpa secara langsung atau melalui telefon bimbit, 012-3723212.



BORANG KEBENARAN

TAJUK KAJIAN:

PENDEDAHAN RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI, TANJUNG KARANG, SELANGOR

Penyelidik:

Saya No Kad Pengenalan
..... Dengan ini secara sukarela bersetuju untuk mengambil bahagian dalam penyelidikan klinikal * (pengajian klinikal, soal selidik kajian atas / dadah percubaan) yang dinyatakan di atas.

Saya telah dimaklumkan tentang maklumat penyelidikan klinikal dari segi metodologi, kesan buruk dan komplikasi yang mungkin (rujuk kepada Bahagian Maklumat). Saya faham bahawa saya mempunyai hak untuk menarik diri daripada penyelidikan ini pada bila-bila masa tanpa memberi apa sahaja alasan. Saya juga faham bahawa kajian ini adalah sulit dan semua maklumat yang diberikan mengenai identiti saya akan kekal sulit dan rahsia.

Saya ingin untuk * tahu / tidak ingin tahu mengetahui keputusan ujian yang dilakukan ke atas sampel saya.

* Potong di mana perlu

Tandatangan Tandatangan
(Responden) (Saksi)

Tarikh: Nama:

I/C No:

Saya mengesahkan bahawa saya telah menerangkan kepada responden sifat dan tujuan penyelidikan klinikal tersebut di atas.

Tarikh Tandatangan
(Penyelidik)

BORANG KEBENARAN (KUMPULAN KAWALAN)

TAJUK KAJIAN:

PENDEDAHAN RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH
PADI, TANJUNG KARANG, SELANGOR

Penyelidik:

Saya No Kad Pengenalan
..... Dengan ini secara sukarela bersetuju untuk mengambil
bahagian dalam penyelidikan klinikal * (pengajian klinikal, soal selidik kajian atas / dadah
percubaan) yang dinyatakan di atas.

Saya telah dimaklumkan tentang maklumat penyelidikan klinikal dari segi metodologi, kesan
buruk dan komplikasi yang mungkin (rujuk kepada Bahagian Maklumat). Saya faham bahawa
saya mempunyai hak untuk menarik diri daripada penyelidikan ini pada bila-bila masa tanpa
memberi apa sahaja alasan. Saya juga faham bahawa kajian ini adalah sulit dan semua
maklumat yang diberikan mengenai identiti saya akan kekal sulit dan rahsia.

Saya ingin untuk * tahu / tidak ingin tahu mengetahui keputusan ujian yang dilakukan ke atas
sampel saya.

* Potong di mana perlu

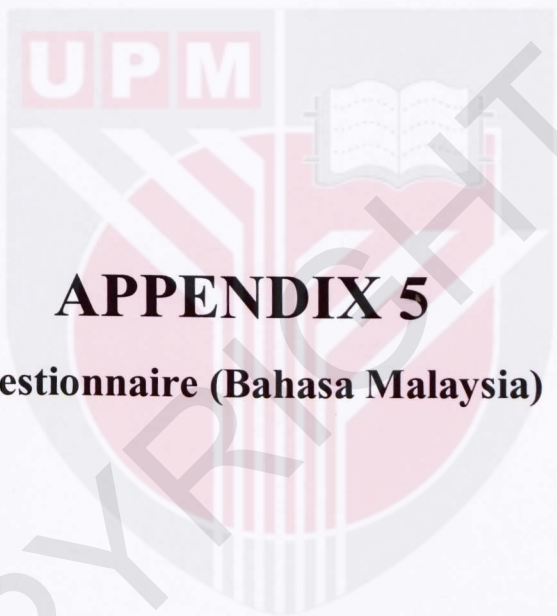
Tandatangan Tandatangan
(Responden) (Saksi)

Tarikh: Nama:

I/C No:

Saya mengesahkan bahawa saya telah menerangkan kepada responden sifat dan tujuan
penyelidikan klinikal tersebut di atas.

Tarikh Tandatangan
(Penyelidik)



APPENDIX 5

Questionnaire (Bahasa Malaysia)





UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

ID Responden:

| | | | | |
|---|--|--|--|--|
| A | | | | |
|---|--|--|--|--|

**JABATAN KESIHATAN PERSEKITARAN DAN PEKERJAAN
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA**

**PENDEDAHAN RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN
PESAWAH PADI DI TANJUNG KARANG, SELANGOR**

Alamat Responden:

.....
.....
.....

No Telefon:

(R)

| | | | | | | | | | | | | |
|--|--|--|--|---|--|--|--|--|--|--|--|--|
| | | | | - | | | | | | | | |
|--|--|--|--|---|--|--|--|--|--|--|--|--|

(Hp)

| | | | | | | | | | | | | |
|--|--|--|--|---|--|--|--|--|--|--|--|--|
| | | | | - | | | | | | | | |
|--|--|--|--|---|--|--|--|--|--|--|--|--|

ARAHAN SOALAN:

1. Borang soal selidik ini mengandungi sebelas (6) bahagian iaitu:

- Bahagian A : Maklumat diri
- Bahagian B : Gaya hidup
- Bahagian C : Latar belakang pekerjaan
- Bahagian D : Maklumat penggunaan racun serangga di tempat kerja
- Bahagian E : Maklumat penggunaan kelengkapan pelindung diri
- Bahagian F : Maklumat kesihatan kulit

2. Anda diminta menjawab semua soalan yang ada dalam buku soalan ini.

3. Untuk menjawab, anda perlulah menandakan ($\sqrt{\quad}$) pada ruangan kotak yang disediakan. Contoh yang terbaik ialah seperti berikut:

| |
|----------------|
| $\sqrt{\quad}$ |
|----------------|

4. Borang soal selidik ini hendaklah diserahkan semula kepada pengkaji setelah selesai menjawab semua soalan.

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

BAHAGIAN A: MAKLUMAT DIRI

1. Umur: tahun

2. Jantina: Lelaki Perempuan

3. Bangsa: Melayu Cina India

Lain-lain (Sila nyatakan):

4. Status: Bujang Berkahwin Duda/Janda

5. Taraf pendidikan:

Tidak bersekolah
 Sekolah Rendah
 Sekolah Menengah
 Sijil

Diploma
 Ijazah Sarjana Muda
 Sarjana Muda
 Doktor Falsafah

6. Jumlah pendapatan sebulan:

RM 0.00 – RM 1 000.00

RM 1 000.01 – RM 2 000.00

RM 2 000.01 – RM 3 000.00

RM 3 000.00 dan ke atas

7. Bilangan anak: orang anak

8. Berapakah umur anak anda? Sila tanda yang berkaitan. _____

< 1 – 5 tahun

6 – 12 tahun

13 – 18 tahun

19 tahun ke atas

9. Berat: kg

10. Tinggi: cm

11. Adakah anda rabun warna?

Ya

Tidak

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA**BAHAGIAN B: GAYA HIDUP**

12. Adakah anda merokok?

 Ya Tidak

13. Pada umur berapakah anda mula merokok?

 tahun

14. Berapa batang rokok anda hisap dalam sehari?

 batang

15. Adakah terdapat perokok lain di dalam rumah anda?

 Ya Tidak

16. Adakah anda mengambil minuman keras / arak?

 Ya Tidak

17. Berapa banyak botol anda minum dalam sehari?

 Botol sehari

18. Apakah hobi anda pada waktu lapang?

 Fotografi
 Berkebun Bermain bola sepak
 Berbasikal / berjogging Bertukang
 Berenang

19. Adakah anda mandi sebelum ke tempat kerja?

 Ya Tidak

20. Adakah anda mandi selepas pulang dari tempat kerja?

 Ya Tidak

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

21. Adakah anda menukar pakaian kerja anda setiap hari?

Ya

Tidak

BAHAGIAN C: LATAR BELAKANG PEKERJAAN

22. Jawatan pekerjaan terdahulu:

23. Jumlah tahun bekerja di tempat terdahulu: tahun

24. Jawatan pekerjaan sekarang:

25. Bilangan tahun anda bekerja di tempat sekarang: tahun

26. Jumlah hari bekerja dalam seminggu: hari seminggu

27. Jumlah masa bekerja dalam sehari: jam sehari

28. Adakah anda merokok di sawah padi?

Ya

Tidak

**BAHAGIAN D: MAKLUMAT PENGGUNAAN RACUN SERANGGA DI TEMPAT
KERJA**

29. Apakah jenis racun makhluk perosak tanaman yang digunakan di tempat kerja anda
sekarang?

- a. Racun Serangga
 b. Racun Kulat
 c. Racun Siput
 d. Racun Cacing

- e. Racun Rumpai
 f. Racun Tikus
 g. Racun Anai-anai
 h. Lain-lain (nyatakan).....

30. Apakah jenis aktiviti yang anda lakukan di tempat kerja?

- a. Membancuh racun
 b. Meracun
 c. Membaja
 d. Membajak
 e. Menuai

31. Nyatakan tempoh masa anda menggunakan racun makhluk perosak tanaman tersebut:

minit

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

32. Apakah jenis penyembur racun yang anda gunakan?



a. Penyembur racun manual



b. Penyembur racun bermotor



c. Penyembur racun bertekanan

33. Nyatakan kekerapan anda menggunakan racun makhluk perosak tanaman dalam sehari:

| | | |
|------------------------|---------------|--|
| Pagi | 0 – 1 jam | |
| | 2 – 3 jam | |
| | 3 – 4 jam | |
| | 4 jam ke atas | |
| Petang | 0 – 1 jam | |
| | 2 – 3 jam | |
| | 3 – 4 jam | |
| | 4 jam ke atas | |
| Sepanjang masa bekerja | | |

34. Adakah anda mandi di tempat kerja selepas menggunakan racun serangga?

Ya

Tidak

35. Apakah formulasi racun serangga yang kerap anda gunakan?

a. Cecair
b. Pepejal
c. Butiran

d. Serbuk
e. Aerosol, asap atau kabus

BAHAGIAN E: MAKLUMAT PENGGUNAAN KELENGKAPAN PELINDUNG DIRI

36. Adakah majikan anda membekalkan kelengkapan pelindung diri kepada anda?

Ya

Tidak

37. Adakah penggunaan kelengkapan pelindung diri wajib digunakan semasa anda bekerja?

Ya

Tidak

38. Adakah anda menggunakan sebarang kelengkapan pelindung diri semasa bekerja?

Ya

Tidak

Jika ya, sila jawab soalan no 39.

Jika tidak, sila terus menjawab soalan no 40.

39. Apakah jenis kelengkapan pelindung diri yang anda gunakan semasa bekerja?

- | | | | |
|--------------------------|------------------------------|--------------------------|-------------------|
| <input type="checkbox"/> | a. But/kasut keselamatan | <input type="checkbox"/> | f. Sarung tangan |
| <input type="checkbox"/> | b. Apron | <input type="checkbox"/> | g. Cermin mata |
| <input type="checkbox"/> | c. Baju kalis air | <input type="checkbox"/> | h. Topeng |
| <input type="checkbox"/> | d. Alat pernafasan | <input type="checkbox"/> | i. Penutup kepala |
| <input type="checkbox"/> | e. Lain-lain (nyatakan)..... | | |

40. Apakah alasan anda jika tidak menggunakan kelengkapan pelindung diri semasa bekerja?

- | | | | |
|--------------------------|---------------------|--------------------------|---------------------------------------|
| <input type="checkbox"/> | a. Tidak selesa | <input type="checkbox"/> | c. Tidak pasti cara penggunaannya |
| <input type="checkbox"/> | b. Tidak dibekalkan | <input type="checkbox"/> | d. Tidak pasti kebaikan penggunaannya |

41. Kekerapan anda menukar kelengkapan pelindung diri kepada yang baru:

- | | |
|------------------------------|-------|
| a. Setiap hari | |
| b. Seminggu sekali | |
| c. Dua minggu sekali | |
| d. Sebulan sekali | |
| e. Lain-lain (sila nyatakan) | |

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

BAHAGIAN F: MAKLUMAT KESIHATAN KULIT

42. Adakah anda mempunyai masalah kulit?

Ya

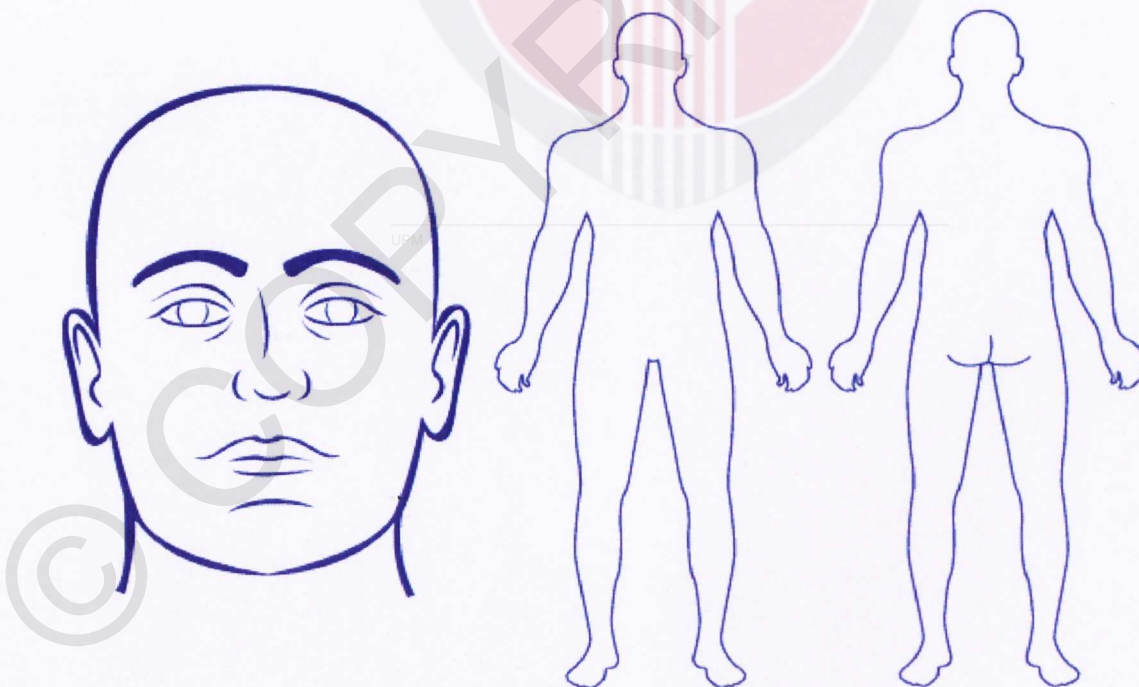
Tidak

43. Tarikh masalah kulit bermula (anggaran):

44. Adakah masalah kulit yang anda alami bermula:

| | |
|---|--|
| a. Serta merta apabila terkena racun makhluk perosak tanaman | |
| b. 1-2 jam selepas menggunakan racun makhluk perosak tanaman | |
| c. 2-4 jam selepas menggunakan racun makhluk perosak tanaman | |
| d. 12 jam selepas menggunakan racun makhluk perosak tanaman | |
| e. 24 jam selepas menggunakan racun makhluk perosak tanaman | |
| f. Seminggu selepas menggunakan racun makhluk perosak tanaman | |

45. Bahagian tubuh yang kebiasaannya mempunyai masalah kulit:
(Tandakan X dimana-mana bahagian)



PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

Sejarah penyakit / masalah kulit

46. Diri sendiri

a. Gatal kulit b. Resdung c. Asma

47. Di kalangan ahli keluarga

a. Gatal kulit b. Resdung c. Asma

48. Nyatakan tanda gejala-gejala masalah kulit anda:

| | |
|---------------------|--|
| a. Gatal | |
| b. Ruam | |
| c. Merah kulit | |
| d. Gelembung kulit | |
| e. Kulit kering | |
| f. Kulit merekah | |
| g. Sakit | |
| h. Kulit membengkak | |

Sejarah Alahan

49. Pernahkah anda mempunyai masalah alahan (Pilih salah satu jawapan di bawah)

| | |
|----------------------------|--|
| a. Kosmetik | |
| b. Krim pelindung matahari | |
| c. Getah | |
| d. Ubat-ubatan | |
| e. Barang kemas | |
| f. Jam | |
| g. Makanan | |
| h. Tumbuh-tumbuhan | |

50. Adakah masalah kulit anda bertambah teruk apabila terdedah kepada cahaya matahari?

Ya Tidak

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

51. Senaraikan jenis ubat-ubatan / vitamin tambahan yang anda makan untuk merawat penyakit kulit anda

- i.
- ii.
- iii.

Sejarah Rawatan

52. Pernahkah anda menjalani ujian tampalan (patch test) sebelum ini?

Ya

Tidak

Jika ya, nyatakan:

53. Bila anda membuat ujian tersebut?

54. Adakah ujian tersebut positif?

Ya

Tidak

55. Apakah rawatan terbaru yang anda ambil untuk masalah kulit anda?

.....

56. Bagaimanakah keadaan masalah kulit anda di hujung minggu atau pada hari tidak bekerja?

| | |
|-----------------|--|
| a.Semakin pulih | |
| b.Seperti biasa | |
| c.Semakin teruk | |

57. Penjagaan diri:

Kekerapan membasuh tangan:

Jenis sabun yang digunakan:

Kekerapan membersihkan diri:

Jenis sabun yang digunakan:

PENDEDAHAN KEPADA RACUN RUMPAI DAN SIMPTOM KULIT DI KALANGAN PESAWAH PADI DI TANJUNG
KARANG, MALAYSIA

58. Masalah kulit yang anda alami di bahagian muka disebabkan oleh:

| | |
|----------------------------|--|
| a.Kosmetik | |
| b.Pewangi | |
| c.Krim pencukur | |
| d.Pewarna rambut | |
| e.Pelembap muka | |
| f.Produk mata, kanta lekap | |

59. Masalah kulit yang anda alami di bahagian dada dan ketiak disebabkan oleh:

| | |
|---|--|
| a.Sabun | |
| b.Deodorant | |
| c.Pewangi | |
| d.Sabun pencuci | |
| e.Pelembut fabrik | |
| f.Losyen / krim badan | |
| g.Jenis fabrik yang digunakan. Nyatakan: | |

60. Masalah ruam yang anda alami di bahagian tangan disebabkan oleh:

| | |
|---|--|
| a.Barang kemas | |
| b.Jam tangan | |
| c.Losyen / krim tangan | |
| d.Sarung tangan. Nyatakan jenis: | |

61. Adakah anda mempunyai masalah kulit yang lain? Nyatakan.

Ya

Tidak

Nyatakan:.....

62. Adakah anda tidak bekerja sekarang disebabkan oleh masalah kulit ini?

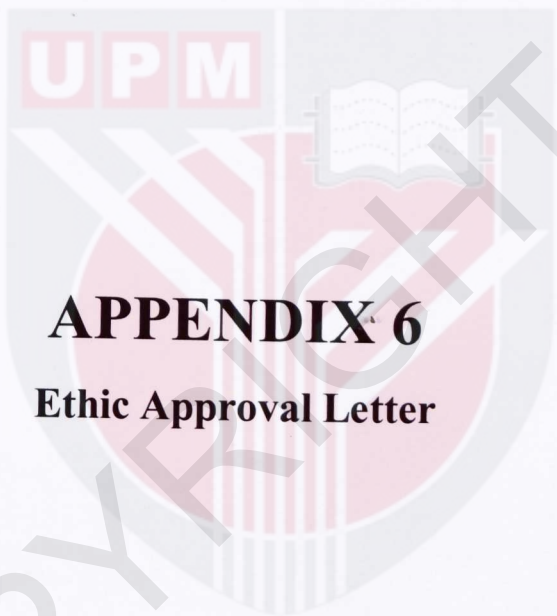
Ya

Tidak

~ Borang soal selidik tamat ~

Terima kasih atas kerjasama yang anda berikan.
Sekian.





APPENDIX 6

Ethic Approval Letter

© COPY RIGHT UPM