UNIVERSITI PUTRA MALAYSIA

THE ASSOCIATION BETWEEN LIVER ENZYMES LEVEL AND EXPOSURE TO HERBICIDE AMONG PADDY FARMERS IN TANJUNG KARANG, SELANGOR DARU LEHSAN

BY
HAFIDA BINTI BAHARUM

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FPSK4 2012 7

ACKNOWLEDGEMENT

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Abstract

Introduction: In the paddy-growing areas in Malaysia, herbicides 2,4-D and paraquat are most commonly used by the farmers. Both are listed class II in the World Health Organization (WHO) classification. Long-term exposure to herbicide, without proper consideration for safety when managing pesticide activities, may cause chronic health problems such as cancer, liver abnormalities and kidney dysfunction. The main objective of this study is to determine the liver enzymes level and exposure to herbicide among paddy farmers **Methodology:** A cross-section analytical study was conducted to evaluate the risk of pesticide exposure to those applying herbicide in the paddy-growing areas of Sawah Sepadan, Tanjung Karang , Selangor, Malaysia. A purposive sampling method was used to select on the respondents based on inclusive criteria such as age between 20 to 60 years, male and have work experience above 6 month. Questionnaire was used to collect information on socio-demographic symptoms of liver injury and skin symptoms. Blood was collected about 5ml by registered medical personnel's and was analyzed by Elisa reader (Elektrospektrofotometer "Cobas Mira"). While Visual Scoring System with Fluorescent Tracers was used to identify skin exposure to herbicide and determinants of Dermal Exposure Ranking Method was used to calculate the exposure of herbicide. **Result:** There was significant different in GGT, ALT and AST enzyme level among exposed group and comparative group GGT (U/l) with $Z = -6.021$, $p < 0.001$, ALT (U/l) with $Z = -6.678$ $p < 0.001$ and AST (U/l) predicted with $Z = -6.325$, $p < 0.001$. Moreover, there was a significant difference in health complaint such as eye itchiness during and after working, nausea during working and skin itchiness with the $p < 0.05$. Mean while, most of the pesticide exposure can be seen on right of the finger (36.9%) of the farmers; thorax back (35.2%) and right palm (25.4%) are the most body part exposed to the pesticide while spraying activity. **Discussion:** From the finding, it shows that there were significant different of liver enzyme level among workers that highly exposed with herbicide and workers that not highly exposed with herbicide. This study indicated that exposure to elevated concentration liver enzyme level to herbicide is the risk factors in the development of skin itchiness, eye itchiness and nausea among farmers. **Conclusion:** The result from this research showed that the farmers that exposed highly exposed to the herbicide have high level of liver enzyme due to the spraying activity. There was an association between the exposure to herbicide and health problems such as skin itchiness, eye itchiness and nausea

Keywords: Paddy farmer; herbicide; DREM; dermal exposure; liver enzymes.

ABSTRAK

PERKAITAN ANTARA ARAS ENZIM HATI DAN PENDEDAHAN KEPADA HERBISIC DIKALANGAN PESAWAH PADI, TANJUNG KARANG ,SELANGOR

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Kata Kunci: Pesawah padi; herbisid; DREM; pendedahan dermal; enzim hati,

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LIST OF ABBREVIATIONS

GGT	Gama-glutamyl transpeptidase
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
DERM	Dermal Exposure Ranking Method
EEM	Exposure Evaluation Matrix
U/l	Unit / litre

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CHAPTER 1

INTRODUCTION

1.1 Background

For all pesticides to be effective against any unwanted organism they are intended to control, they must be biologically active, or toxic. Because pesticides are toxic, they are also potentially hazardous to humans, animals, other organisms, and the environment. Hazard, or risk, of using pesticides is the potential for injury, or the degree of danger involved in using a pesticide under a given set of conditions. Hazard depends on the toxicity of the pesticide and the amount of exposure to the pesticide and is often illustrated with the following equation:

Hazard = Toxicity x Exposure

The toxicity of a pesticide is a measure of its capacity or ability to cause injury or illness. The toxicity of a particular pesticide is determined by subjecting test animals to varying dosages of the active ingredient (a.i.) and each of its formulated products. The active ingredient is the chemical component in the pesticide product that controls the unwanted organism.

Most paddy farmers are using agricultural chemicals on their paddy fields. Many of these chemicals are used to destroy or inhibit the growth of plants, especially weeds and are known as herbicide. Herbicide can be considered according to their chemical basis. The types of herbicides that are commonly used are includes Paraquat, 2, 4-dichlorophenoxyacetic acid, Glyphosate, Acetochlor, Atrazine, Dicamba, Mecoprop, Metolachlor, , Pendimethalin, and Propanil (Willoughby and Ohio , 2006). However according to Mohd Rafee *et. al.*, (2011) in the paddy-growing areas in Malaysia, the herbicides 2,4-D and paraquat are most commonly used by the farmers. The pesticide 2,4-D is a systemic herbicide used for postemergence control of annual and perennial broad-leaved aquatic weeds in paddy fields (Sonn *et. al.*,1994) Paraquat, a contact, non-selective herbicide, is effective in controlling a wide range of grassy and broad-leaved weeds (WHO, 1991). Both herbicides are listed under class II in the World Health Organization (WHO) classification, which means they are moderately hazardous to human health.

Most of the more toxic herbicide falls into chemical group parquat that inflicts at least part of its damage by generating free radicals (Reiter, 1995). Parquat is used in over 120 countries, commonly sold as Gramoxone, a 20% solution. It is currently the third best-selling pesticide globally (Catharina, 2001).

The first widely used herbicide was 2,4-dichlorophenoxyacetic acid, often abbreviated 2,4-D by Peterson (1967). It was first commercialized by the paint company Sherwin-Williams and saw use in the late 1940s. It is easy and inexpensive to manufacture, and kills many broadleaf plants while leaving grasses largely unaffected, although high doses of 2, 4-D at crucial growth periods can harm grass crops such as maize or cereals. The low cost of 2, 4-D has led to continued usage today and it remains one of the most commonly used herbicides in the world. Like other acid herbicides, current formulations utilize either an amine salt or one of many esters of the parent compound. These are easier to handle than the acid.

2,4-D exhibits relatively good selectivity, meaning, in this case, that it controls a wide number of broadleaf weeds while causing little to no injury to grass crops at normal use rates. An herbicide is termed selective if it affects only certain types of plants, and nonselective if it inhibits a very broad range of plant types. Other herbicides have been more recently developed that achieve higher levels of selectivity than 2, 4-D.

The 1950s saw the introduction of the triazine family of herbicides, which includes atrazine, which have current distinction of being the herbicide family of greatest concern regarding groundwater contamination. Atrazine does not break down readily (within a few weeks) after being applied to soils of above neutral pH. Under alkaline soil conditions atrazine may be carried into the soil profile as far as the water table by soil water following rainfall causing the aforementioned contamination. Atrazine is thus said to have carryover, a generally undesirable property for herbicides.

Glyphosate, frequently sold under the brand name Roundup, was introduced in 1974 for non-selective weed control. It is now a major herbicide in selective weed control in growing crop plants due to the development of crop plants that are resistant to it. The pairing of the herbicide with the resistant seed contributed to the consolidation of the seed and chemistry industry in the late 1990s.

Many modern chemical herbicides for agriculture are specifically formulated to decompose within a short period after application. This is desirable as it allows crops which may be affected by the herbicide to be grown on the land in future seasons. However, herbicides with low residual activity (i.e., that decompose quickly) often do not provide season-long weed control.

Acute toxicity of herbicide refers to the chemical's ability to cause injury to a person or animal from a single exposure, generally of short duration. The harmful effects that occur from a single exposure by any route of entry are termed "acute effects." The four routes of exposure are dermal (skin), inhalation (lungs), oral (mouth), and the eyes. Herbicides have widely variable toxicity. In addition to acute toxicity from high exposures there is concern of possible carcinogenicity as well as other long-term problems such as contributing to Parkinson's disease, acute renal failure and deranged liver function (Morrison, 1992). Furthermore, one study was reported a patient presenting with acute renal failure and deranged liver function after skin and lips contact with inappropriately diluted paraquat (Wong *et al*; 2011). Therefore, from the case study it show that people will experience with liver injury after exposed to the herbicide with high concentration via direct contact of the herbicide. Moreover, there are several sources said that liver problems and nerve damage may result from chronic herbicide exposure, while chloracne is a classic symptom of herbicide dermal exposure. Table 1.0 shows toxicity categories of active ingredients in herbicide that Adapted from 40 CFR, Part 156.

Table 1.0 Toxicity Categories of Active Ingredients in Herbicide

Routes of Exposure	Toxicity Category			
	I	II	III	IV
Oral LD50	Up to and including 50 mg/kg	50-500 mg/kg	500-5,000 mg/kg	>5,000 mg/kg
Inhalation LC50	Up to and including 0.2 mg/l	0.2-2 mg/l	2-20 mg/l	>20 mg/l
Dermal LD50	Up to and including 200 mg/kg	200-2,000 mg/kg	2,000-20,000 mg/kg	>20,000 mg/kg
Eyes Effect	Corrosive corneal opacity not reversible within 7 day	Corneal opacity Reversible within 7 day; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 day	No irritation
Skin effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

Sources: 40 CFR, Part 156

Liver injury is any condition that causes liver inflammation or tissue damage and affects liver function. The liver is a vital organ located in the upper right-hand side of the abdomen. It is as large as a football, weighs 2-3 pounds, and performs numerous functions for the body: producing proteins and enzymes, maintaining hormone balances, and metabolizing and detoxifying substances that would otherwise be harmful to the body. The liver makes factors that help the human immune system fight infection, removes bacteria from the blood, and makes bile, which is essential for digestion. According to the John (2002), liver is an important route for excretion of certain foreign or toxic compound in human body. Bile is secreting in the liver by the hepatocytes into the canaliculi and it flows into the bile duct and eventually into the intestine. However, high concentration of toxic substances such as paraquat will affect the liver function that can influence liver injury. Accoding to the Benedetti *et al.,* (2004) long-term treatment of rats with low doses of Glyphosate-Biocarb® which is one of the active ingredients in herbicide were increased release of hepatic-aspartate Aminotransferase (AST) and alanine aminotransferase (ALT) to serum of animals. This was accompanied by changes in hepatic liver tissue, with larger deposition of reticulin fibers followed by increase in Kupffer cells, suggesting the increase in connective tissue. These data suggest some degree of hepatic toxicity of this product and raises the necessity of deeper studies about side effects related to its manipulation.

1.2 Problems Statement.

Herbicide contains a large number of toxic active principles, each of which may be employed in a vast number of different formulations. Many of these products contain toxic substances such as coadjuvants, adhesivants, wetting agents and solvents for which the manufacturer does not always indicate the concentration.

Furthermore, herbicide can also cause moderate hepatotoxicity after direct contact with it. Liver involvement in acute paraquat poisoning is self-limited and usually consists of cholestasis. However, long-term hepatic effects after paraquat exposition have not been described up to now, probably because of the high mortality rate of this acute poisoning. Moreover, this study was reported the case of an agricultural worker who developed persistent cholestasis after an episode of acute paraquat poisoning through skin absorption (Ramón Bataller, 2000). Thus, only a few studies have done by looking into the association between dermal contact and liver enzyme level among herbicide user at paddy field.

Therefore, the study is to answer some question about the association between dermal exposure and liver enzyme level such as γ-glutamyl transpeptidase (GGT), alanineaminotransferase (ALT) and Aspartate Transaminase (AST) after long term exposure among herbicide user at paddy field. This studied also done due to the use of herbicide among paddy farmers who are frequent use to remove unwanted plant such as weed before planting the new paddy. According to frequently used make of herbicide, make the researcher determine the association between dermal contact and liver enzyme level between two groups which is exposed and unexposed group.

1.3 Study Justification

The study is to determine the association between dermal contact and liver enzyme level such as AST, ALT and GGT as a result of the effects of long tern exposure to herbicide in the loop as a group of workers exposed to herbicide. Meanwhile, other workers as a group are not equally exposure. Several studies have been done before, for example, ''In vitro'' studies have found that glyphosate and paraquat are able to inhibit certain enzyme activities: alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and acetyl cholinesterase (AChE) (Demerdash, 2001).

As we know, there is a large population of Malaysia who involved in the use of herbicide especially who involve in agriculture site. They are composed of farmers involved in commercial agriculture or small scale, and employees who work in the garden. Furthermore, use of herbicide among paddy farmers at paddy field very necessary and important to enhance safety environment to farmers and public as well. Dermal exposure was the most likely route of uptake in studies that reported paraquat in urine. Paraquat is poorly absorbed through intact skin, but penetration is considerably increased by damage to the skin, which is of particular concern because paraquat itself is a skin irritant (Wesseling, 2001) Moreover, only a few studies have done in Malaysia about the association between dermal contact of herbicide and liver enzyme level after too long exposed with herbicide among paddy farmers.

Therefore, this study is very important to evaluate the effects that have occurred as a result of exposure to herbicide via dermal contact. The results of this study are expected to assist management in order to address the problem of poisoning among workers in the exposed group. Moreover, methods for measuring levels of liver enzymes such as AST, ALT and GGT among herbicide user in the exposed group and other workers as a group not exposed. This is used as a biological indicator of exposure to herbicide. In fact, this method can be used as a reliable early detection of toxicity resulting from exposure to herbicide, especially the effects of which cannot be demonstrated by clinical signs. In this study the researcher would expect to find effective and appropriate use of biological indicators for tracking the impact and consequences of such exposure.

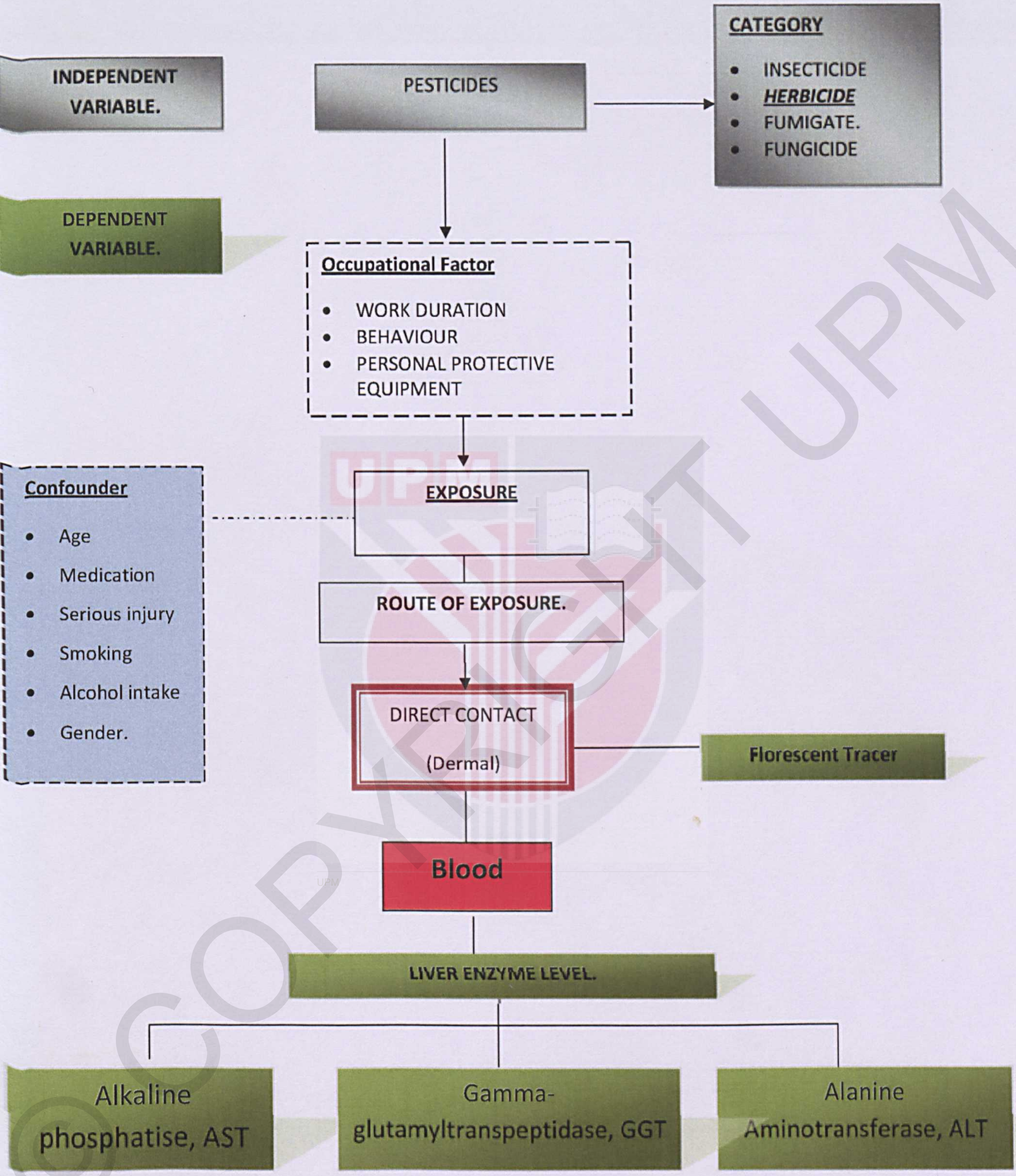

Figure 1.0 conceptual framework of research activities.

1.4 Conceptual Framework

This will use to assist and guide researcher in implementing the study. The aim of this study is to determine the association between dermal exposure and liver enzymes level after chronic exposure to the herbicide among paddy farmers. From the framework, paraquat and glyphosate, 2,4-D are types of the herbicide that is usually used in the agriculture group, the exposure will be measured on paddy farmers only. There are three pathway that the herbicide can enter human body that is by consuming the contaminated food or water with herbicide (ingestion), by inhaling the contaminated air with herbicide (inhalation) and by directly skin contact with the herbicide or contaminated air with herbicide (direct contact). The exposure will give adverse health effect to human organ system such as to their respiratory system, cardiovascular system, nervous system kidney failure and liver injury.

This research was focused on the effect of herbicide to the worker's liver enzyme level, where the exposure level of herbicide that penetrate in their body via direct contact during their work activities was measured by taking their blood by registered personnel. Furthermore, by using visual scoring systems and fluorescent tracers to quantify dermal exposure (Aragon' et al, 2004) is to determine the main body part of the paddy farmers exposed to the herbicide during their work activities. From this test, the association between dermal contact and liver enzyme level of the farmers that are mainly exposed to the herbicide whiles the working activities was obtained. On the other part, the medical status on the farmers was observed and determined by using questionnaire and Modified contact-dermatitis questionnaire (Mc Gill university Health Care, 1999)

1.5 OBJECTIVE.

1.5.1 General

To determine the liver enzymes level and dermal exposure to herbicide among paddy farmers.

1.5.2 Specific.

1. To determine of background information and work information of farmers
2. To determine the personal protective equipments and other protective measure among farmers.
3. To determine the distribution of dermal scoring from Dermal Exposure Ranking method among farmers.
4. To identify the main body part of the paddy farmers exposed to the herbicide during their work activities.
5. To compare the liver enzymes levels between exposed with comparative group of farmers.
6. To compare the health complaint between exposed with comparative group of farmers.
7. To determine the association between the duration of exposure to herbicide with liver enzyme levels among paddy farmers.

8. To determine the association between skin exposure with liver enzyme level among the respondents.
9. To identify the selected variables that influences health complain among farmers among farmers.
10. To identify the selected variables that influences skin symptoms among farmers
11. To identify the selected variables that influences the increasing of dermal scoring from Dermal Exposure Ranking Method among farmers
12. To identify the selected variables that influences the liver enzyme level among farmers.

1.6 HYPOTHESIS

1. The exposed groups have significantly higher liver enzymes level such as GGT, AST and ALT compared to comparative group of paddy farmers.
2. The exposed workers have significantly higher health complaint than the comparative group of paddy farmers.
3. The duration of exposure to pesticide is significantly associated with liver enzyme levels.
4. The skin exposure is significantly associated with liver enzyme levels among paddy farmers.
5. There are selected variables such as type of sprayer equipments, time of working and activities can influence health complains among paddy farmers.
6. There are selected variables such as exposure duration with herbicide, type of sprayer equipment and activities can influence skin symptoms among paddy farmers.
7. There are selected variables such as exposure duration with herbicide, type of sprayer equipment and activities can influence dermal score among paddy farmers
8. There are selected variables such as employment years and smoking habit can influence liver enzyme level among paddy farmers.

1.7 DEFINITION OF TERM.

1.7.1 Conceptual.

1.7.1.1 Dermal Contact

In typical work situations, skin absorption is the most common route of poisoning from pesticides. Absorption will continue as long as the pesticide remains in contact with the skin. The rate at which dermal absorption occurs is different for each part of the body (Figure 1.0). The head (especially the scalp and ear canal) and the genital areas are particularly vulnerable. The relative absorption rates are determined by comparing each respective absorption rate with the forearm absorption rate. This absorption may occur as a result of a splash, spill or drift when mixing, loading or applying a pesticide. It may also result from exposure to residue on application equipment, protective clothing or treated surfaces after pesticide application. The dermal toxicity of a pesticide depends on the pesticide formulation, the site of contamination and the duration of the exposure. In general, pesticides formulated as wettable powders, dusts or granules are not absorbed as readily through the skin as liquid formulations. The hazard from skin absorption increases when workers are mixing pesticides because they are handling concentrated pesticides that contain a high percentage of active ingredients. Certain areas of the body such as the genital area and eyes absorb pesticides easily and rapidly. It is easy to transfer pesticide residues from one part of the body to another. When this occurs, the applicator increases the potential for pesticide poisoning. For example, residues can be inadvertently moved from a hand to a sweaty forehead (4.2) or to the genital area (11.8). At this very high rate, the absorption of a pesticide is more dangerous than swallowing it. A cut can greatly increase pesticide absorption. Absorption is a particular hazard through cut or abraded skin on the hands or face (dams, 1995)

The rates of absorption relative to the forearm which is given the rating of 1

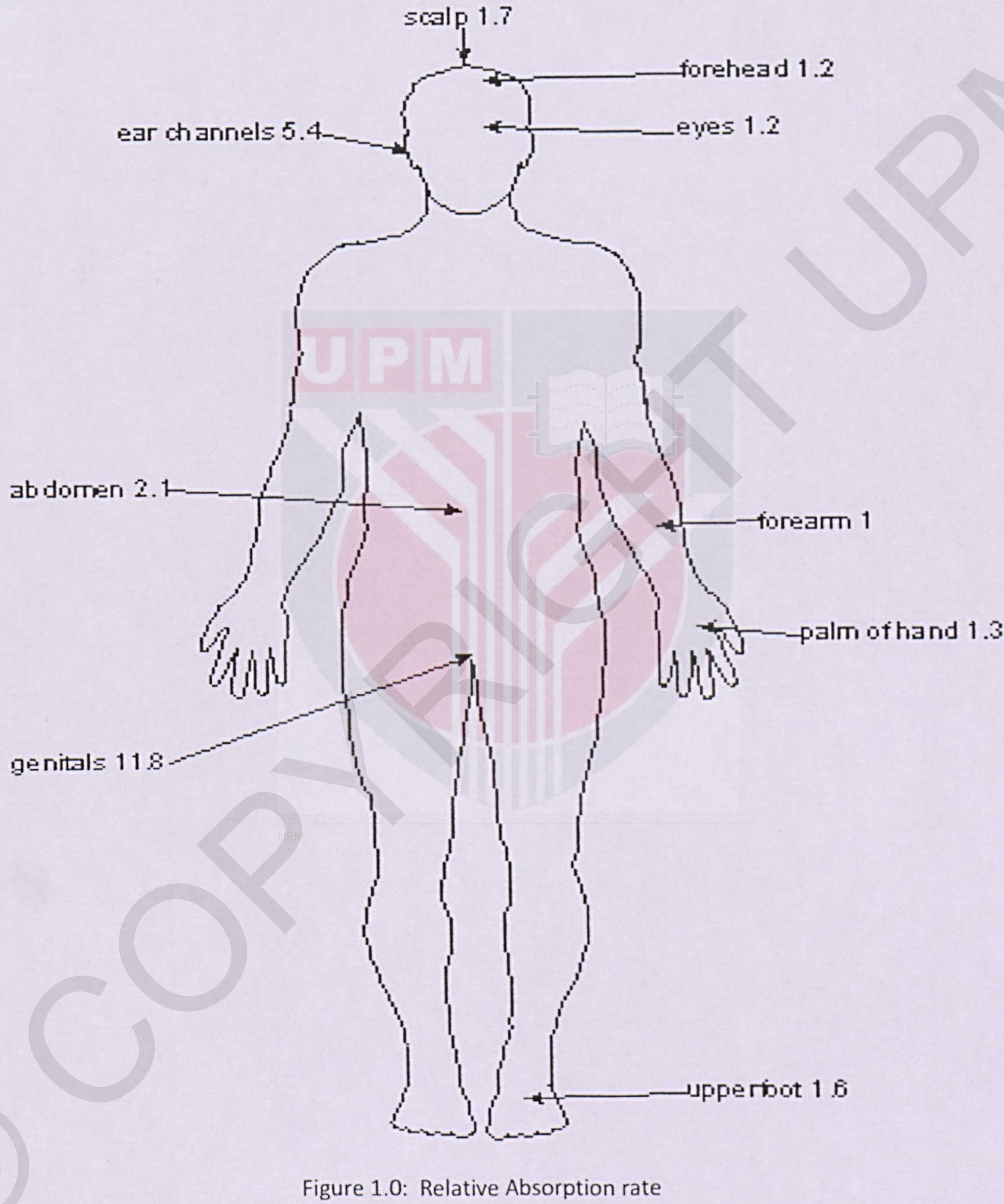

Figure 1.0: Relative Absorption rate
Sources : Rice Knowledge Bank

1.7.1.2 Liver Enzyme

AST (aspartate aminotransferase), also called SGOT (serum glutamic oxalacetic transaminase) is an enzyme found mainly in the liver and heart muscle which is released into the blood when either of these organs is damaged. The normal reference range is 10 to 40 international units per liter (IU/L). There is a possibility of normal aminotransferase (both AST and ALT) levels in people with established cirrhosis. Alanine Aminotransferase,ALT, enzyme that made in liver cells. If liver cells are damaged or die, ALT leaks out into the bloodstream. This is the most important test to follow in a person with liver disease. A high ALT may mean a high degree of liver cell damage. However, ALT levels can also vary and do not always reflect the degree of liver cell damage. A liver cell biopsy will give the most accurate information. The ALT enzyme is a more accurate marker of liver damage and the Normal Range between 7 - 56 U/L. Finally, Gamma-glutamyltranspeptidase,GGT, enzyme that made in the bile ducts. High levels may mean problems with the liver's bile ducts. This is an enzyme made Explanation of Test Result: GGT is a very sensitive test, and can elevate if you use drugs or alcoholand the normal range is 7 - 64 U/l. (Koay, 2002, p. 396-399)

1.7.2 Operational.

After long exposed to herbicide via dermal contact can affect liver enzyme level. The liver enzymes as an indicator of liver injury and it will be measured aspartate aminotransferase (AST) enzyme level, Alanine Aminotransferase (ALT) enzyme level and Gamma-glutamyltranspeptidase (GGT) enzyme level. When the liver enzyme level not normal it will increase the level of this enzyme more than the normal value. Blood sampling is one of the methods that can identify the normality of the liver enzyme. About 10μL of serum was take and it also was analyzed by using Electrospectrophotoeter to identify the level of liver enzyme. On the other site, for dermal exposure can be measured using visual scoring system with fluorescents tracer.

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, nematicides, fungicides, herbicides, and rodenticides, which is the agents primarily effective against insects, nematodes (or roundworms), fungi, weeds, and rodents, respectively. They can be divided into few classes including organophosphorous (OPs), organochlorine (OC), carbamates, and synthetic pyrethroid.

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 (Fig. 2). 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.

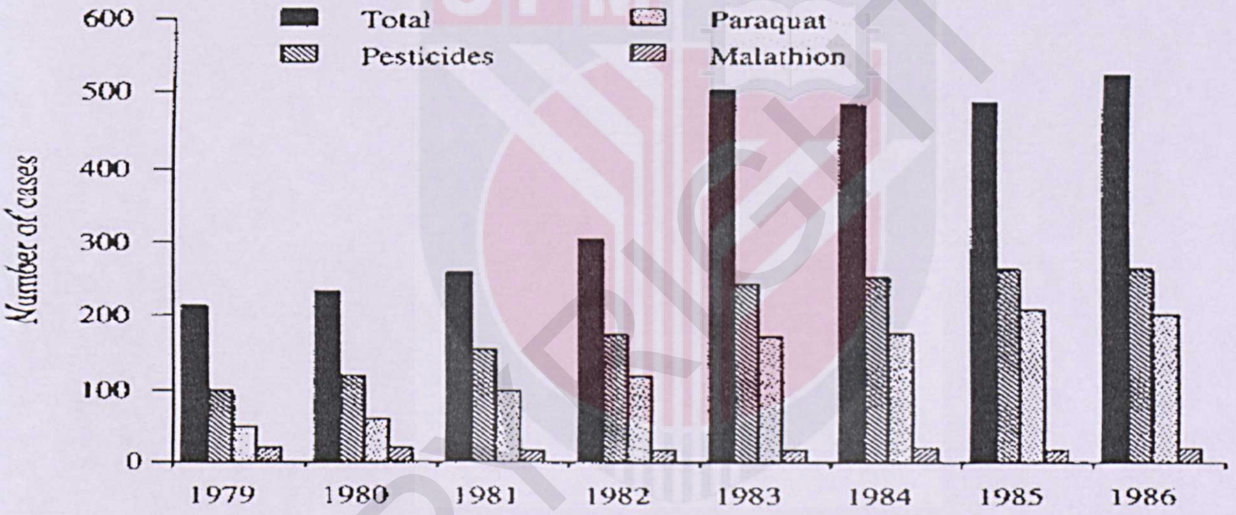

Figure 2.0: Cases of poisoning from pesticides, malathion, paraquat, and all substances Malaysia, 1978-1986 (Sinnaia 1989).

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 (Vencill *et. al.*, 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).

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 0.0001-0.0()47 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%).

Protective clothing made of plastic or rubber material causes discomfort when worn for more than 3 h under the hot, humid field conditions of the tropics (Lee *et. al.*, 1987; Jusoh *et. al.*, 1988). Yet protective apparel is essential if minimal exposure to sprayed pesticides is to be achieved, especially when perennial crops taller than 150 cm are sprayed using ground applicators (Lee 1987). There is some interest in searching for a more suitable material for protective clothing. To date, only two lightweight disposable materials have been developed: Dupont Tyvek and Kimberley Clark Kleengard EP (Lee *et. al.*, 1987).

2.3 Effect of herbicide on Liver Enzyme

`Paraquat poisoning is associated with very high mortality and often results in severe complications including pulmonary fibrosis and multi-organ failure. Majorities of the reported cases had paraquat exposure from oral route either due to accidental intake or suicidal attempt. Systemic complications from dermal exposure were infrequently reported. We reported a patient suffering from acute renal failure and liver function derangement due to systemic absorption of paraquat from accidentally dermal and mucosal contact. The case has illustrated the danger of improper use of this high toxic substance as a household product. From the study it show that the alanine aminotransferase (ALT) level increased to 124 U/L (reference range: 10-57 U/L) and ALP increased up to 260 U/L on day 2 and day 3 after admission respectively. Serology tests for hepatitis B and C were negative. The liver function derangement resolved slowly. He was discharged on day 5. His lips and skin erosions gradually healed but his liver function was still mildly deranged with ALP 245 U/L and ALT 81 U/L on discharge. A follow-up appointment was arranged 2 weeks after discharge but defaulted by the patient.

On the other site, the hepatotoxicity of atrazine was investigated by studying clinical parameters related to hepatic function and by electron microscopy. Three groups to male albino rats (Wistar strain) received 100, 209 and 400 mg of atrazine/per kg of body weight/per day, for 14 days. One group received 600 mg atrazine/per kg of body weight/per day, for 7 days. At termination of dosing, the animals were sacrificed and blood was drawn for the determination of serum total lipids, glucose, alanine aminotransferase (ALT) and alkaline phosphatase (ALP). A dose dependent decrease in serum glucose concentration was observed in all the groups. In contrast, a dose relate increase in total serum lipids, was apparent at all dose levels studied. Activity of serum ALT and ALP increased approximately 60% and 200% respectively in rats given 600 mg atrazine/kg bw for 7 days. The liver was examined grossly and microscopically. Electron microscopy disclosed no changes in the hepatocytes of rats treated with the low dose (100 mg/kg bw). At high doses, electron microscopy revealed hepatocytic proliferation and degeneration of smooth endoplasmic reticulum, lipid accumulation and alteration of bile canaliculi proportional to dose and duration of treatment (C. Santa Maria, 2006).

2.4 Mechanism of Liver Injury.

Liver is one of the organs that will receive nutrients, xenobiotic substances and toxic substances that absorbed via blood stream (Kahl, 1999). The methabolism of foreign substances will increase due to absorption of toxic substances into systemic vena and lately go to the portal vena of liver. About 100% of toxic substances will be undergoes one cycle, and after that will enter the liver (Bull *et. al.*, 2006)

Studied was done by looking the concentration of amino transferase as an evidence of liver cells was destroyed. This method was used in diagnosis of liver diseases. Catalyst of Alanine Transaminase (ALT) and Aspartate Transaminase (AST) enzyme are appear in high concentration in hepatocytes and will be change from alpha-amino alanine group and aspartate group into alpha-keto acid cetoglutaric groups. Thus, the liver enzyme will be release out from the liver due to the leakage of liver membrane or hepatocytes and lately the toxic substances also will released into the blood system (Boobis *et. al.*, 2008)

2.6 Xenobiotic Biotransformation.

Xenobiotic biotransformation is the process by which lipophilic foreign compounds are metabolized through enzymatic catalysis to hydrophilic metabolites that are eliminated directly or after conjugation with endogenous cofactors via renal or biliary excretion. These metabolic enzymes are divided into two groups, Phase I and Phase II enzymes (Oesch et al. 2000, Rendic & Di Carlo 1997) (Figure 2.1).

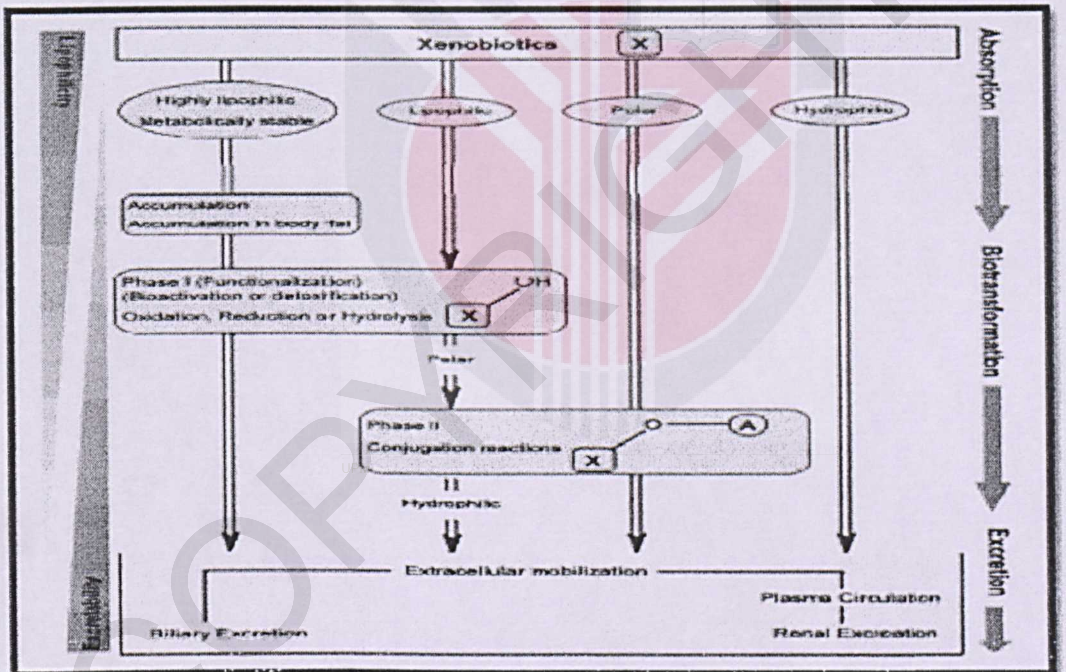

Figure 2.1: Xenobiotic metabolism. In general, a parent compound is converted into an intermediate metabolite which is then conjugated, but metabolism may involve only one of these reactions. Some metabolites are more toxic than the parent compound. (Modified from Ahokas & Pelkonen 2007, Liska et al. 2006).

Phase I reactions, considered as functionalization reactions, add or uncover functional groups on xenobiotics with increasing polarity or nucleophilicity that create a suitable substrate for Phase II metabolism. Phase I reactions generally involve oxidation, reduction and hydrolytic reactions as well as other rarer miscellaneous reactions. These reactions are mediated primarily by the cytochrome P450 family of enzymes, but other enzymes (e.g. flavin monooxygenases, peroxidases, amine oxidases, dehydrogenases, xanthine oxidases) also catalyze the oxidation of certain functional groups. In addition to the oxidative reactions there are different types of hydrolytic reactions catalyzed by enzymes like carboxylesterases and epoxide hydrolases (Hodgson & Goldstein 2001, Low 1998, Parkinson 2001).

Phase I products are not usually eliminated rapidly, but undergo a subsequent reaction in which an endogenous substrate such as glucuronic acid, sulfuric acid, acetic acid, or an amino acid combines with the newly established functional group to form a highly polar conjugate to make them more easily excreted. Sulfation, glucuronidation and glutathione conjugation are the most prevalent classes of phase II metabolism, which may occur directly on the parent compounds that contain appropriate structural motifs, or, as is usually the case, on functional groups added or exposed by Phase I oxidation (LeBlanc & Dauterman 2001, Rose & Hodgson 2004, Zamek-Gliszczynski et al. 2006).

2.7 Visual Scoring System with Fluorescent Tracers to Assess Dermal Pesticide Exposure

Through another study (Arago´n, 2004), recognition and control of dermal exposures can be enhanced significantly by an evaluation method which provide results on-site without chemical analyses. This study is discussing on the development and testing of a visual scoring system for evaluating dermal exposure with fluorescent tracers. The system is designed to allow observers to translate subjective observations into a score based on a simple two dimensional exposure matrix.

The fluorescent tracer technique has been occasionally used in developing countries as part of educational programs for agricultural workers. Fluorescent tracers have been used since the 1980s to visualize dermal exposure of pesticides with ultraviolet light (Franklin et al., 1981; Fenske et al., 1986).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, 1990). It has also been used for evaluating performance of protective devices, and for educational purposes (Houghton et al., 1999). A further development of the method was the Video Imaging Technique to Assess Exposure (VITAE) (Fenske et al., 1986). VITAE have been shown to perform well with substances such as malathion (Fenske, 1988a) and pirimicarb (Archibald et al., 1994).

2.8 Mechanism of Dermal Absorption

The skin is composed of two layers. The outer dead layer of squamous keratinocytes is a thin layer called the epidermis or the stratum corneum. This layer is highly hydrophobic and provides the protective barrier function of skin. Beneath the epidermis is a much thicker living layer of cells including blood vessels, nerves, hair follicles, and sweat glands. The uptake of chemicals through these two skin layers is controlled by diffusion. There are no active transport mechanisms. Chemicals deposited on the outside of the skin set up a concentration gradient between the outer skin concentration and the concentration within the richly perfused dermis. This gradient produces a mass transfer that is dependent on the physical properties of the skin at that site and also the chemical properties of the substance. Diffusion across the complex membrane of the skin is therefore regulated by Fick's law, which states that the rate of diffusion across a barrier will be directly proportional to the concentration gradient (Vermeulen *et. al*., 2002)

2.9 Skin Effects

Dermal exposure is an important factor in risk characterization. In occupational settings it becomes relatively more important because of the continuous reduction in inhalation exposure (Boogaard, 2008). According to the Boogaard, 2008 also, historically, in occupational health settings the emphasis of exposure assessment was on the inhalation routes, whereas in the public health arena also the oral routes, that is, intake via food and drinking water, got attention. However, more recently, dermal exposure routes have come more into focus. This is especially the case in the occupational situation where continuous reduction of inhalation exposures made the relative contribution of dermal exposures more relevant. Moreover, according to the Semple, 2003 the degree of exposure may vary from small quantities of dilute material deposited accidentally on small areas of skin through to repeated immersion of the hands and forearms in concentrated solutions. Environmental and consumer exposures also take place from bathing and swimming in water containing chemicals and from handling or touching surfaces contaminated with pesticides or biocides.

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, and 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

CHAPTER 3

METHODOLOGY

3.1 Study Location

This research was conducted at the paddy field in Sawah Sempadan, Block A – XY, Tanjung Karang, Selangor for the exposed group and comparative groups.

3.2 Study Design.

A Cross-sectional comparative study design was selected in this study to assess the effect of herbicide on the liver enzymes (GGT, ALT and AST) level that was exposed via dermal contact 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 such as mixing, spraying and holding in their job tasks.

3.3.2 Sample Frame

The sampling frame of this study was the paddy farmers that obtained from the Tanjung Karang Farmer's Organizations Officer. Farmers who was fulfill the inclusion criteria were included in the study

Inclusion criteria

1. Paddy farmers aged from 20 and 60 year were recruited to participate in the study based on their potential for exposure to pesticides (Antonio F.,2006).
2. Paddy farmers that use herbicide during their workers activity,
3. Paddy farmers that not suffer with liver diseases such as hemachromatosis, Wilson's disease, Alpha-1-antitrypsin deficiency, Autoimmune hepatitis, Celiac disease, Crohn's disease and ulcerative colitis, Viral Infection (hepatitis A,B,C), Cancer liver (Siamak, 2009).

4. Paddy farmers not take any medication that can influence liver enzyme level such as Pain relief medications, Anti-seizure medications, Antibiotics, Cholesterol lowering drugs, Cardiovascular drugs , Antidepressant drugs (Siamak 2009).
5. Paddy farmers who work on the paddy field 6 months above due to their potential for exposure to pesticides (Antonio F,2006)..

3.3.3 Sample Size

Below is the sample size calculation by using Rubinson &Neutens formula,(1987).This formula is used in this study as to compare among expose-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 z= 1.96, e = 0.10

Calculation for Exposed Group:

p = 0.135 based on study done by Azizi, 2000

$N = (1.96/0.10)^2 (0.135)(0.865)$

N = 38.6805

N = 39, 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% x 38.6805

=7.7361

=8

=39 + 8

= 47 respondents

Thus the total sample size is 47 respondents for exposed and control group.

However, respondents was undergoes dermal test in the dark room and lately the result was calculated by referring the Dermal Exposure ranking Method (DERM). According to the dermal scoring from Dermal Exposure Ranking Method about 45 farmers fulfill the criterion for exposed groups which is having high dermal scoring. While about 30 farmers fulfill the criterion for control group which is having low dermal scoring.

3.4 Instrumentation

3.4.1 Approval Letter

Application letter was used to get respondents to involve in this study and the approval letter from the employer was used to approve the workers involve in this study.

3.4.2 Questionnaire

The questionnaire was distributed to the respondents to gathered information from the workers. The set was consists of personal information, socio-demographic, work activities, exposure history, year of work, and duration of work each day, history of pesticides usage and health status of the workers, symptoms of liver injury and also there will be the modified contact dermatitis questionnaire included from Mc Gill University Health Care, 1999. The questionnaire was modified in Malay version since Malay language is our national language and the language is understood by most of citizens. Some diagrams and pictures was added into the second of questionnaire to make respondents more understands what researchers are going to ask and achieve 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 Observation procedure

In the field, before the observation the tracer was placed into the tank of the backpack 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 dark room that was provided by the researcher. A hand was hold UV lamp (UVP, model UVSL-26P) without filter was used for illumination. The observation procedure inside the foldaway dark room has been described by Aragon *et al.*, (2004)

3.4.3.3 Body Surface Segments

To evaluate the whole body surface, the body was divided into

1. Face
2. Neck
3. Trunk
4. Upper arms
5. Forearms
6. Hands
7. Legs
8. Feet

For ethical reasons, thighs remained covered and could not be considered for scoring. This resulted in 27 body segments scored for all.

Table 1. Body segments defined for the Visual Scoring System

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 Excluded	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

Table 3.0: Body Segment Define For Total Visual Scoring Systems

3.4.3.4 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 3.0*). 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 (see Figure 3.2).

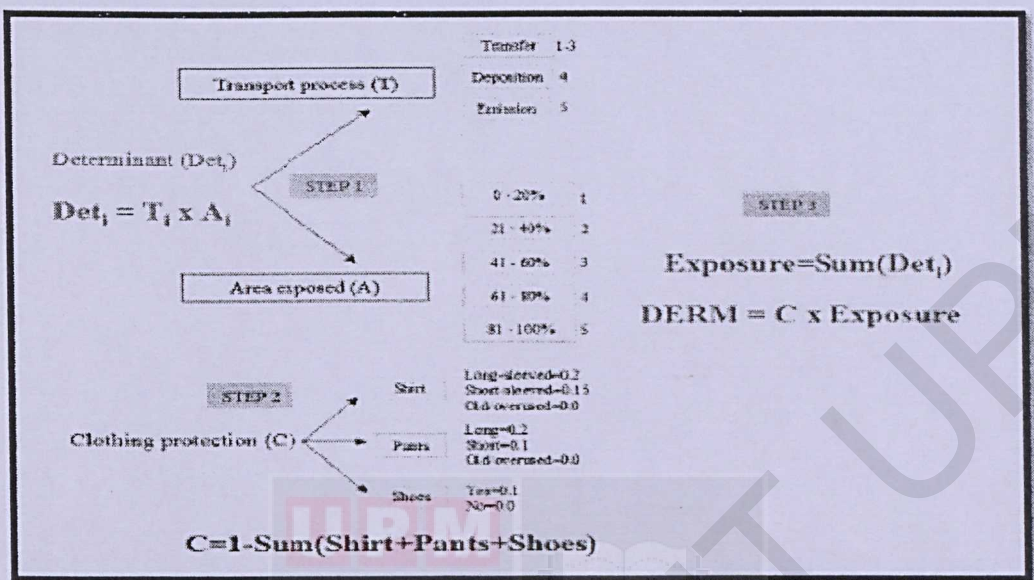

Figure 3.1: Scheme of the DREM algorithm

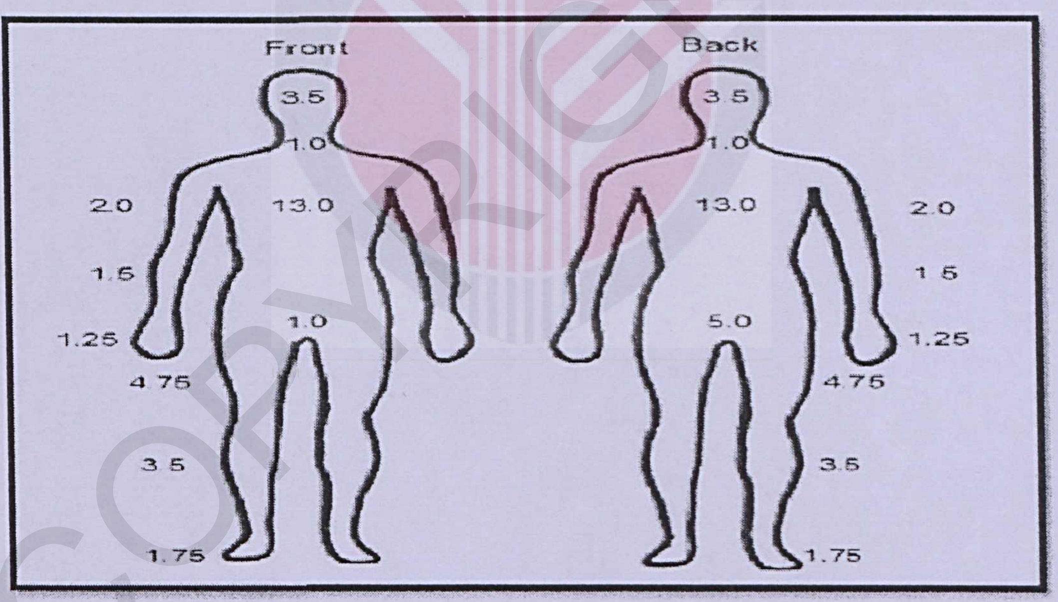

Figure 3.2: Guideline to estimate the area (%) if the body surface affected for each determinant: for upper and lower extremities the figures here represent only one side of the body.

3.4.4 Blood Sampling

The equipments were used in the recruitment of blood are:-

i. Syringe needle
ii. Syringe
iii. 70% alcohol swabs for skin disinfection
iv. Cotton-wool ball to be applied over puncture site
v. Tourniquet.
vi. Container of specimen
vii. Ice box to store the specimen during delivery process.

3.4.4.1 Blood Collection

Venal blood was collected from the respondents by registered medical personnel's registered medical personnel's. About 5ml blood was collected from respondent. According to WHO, needle and syringe system will use while taking the blood sample. Firstly, remove the syringe from the packaging and insert the nozzle of the syringe firmly into the exposed hub of the capped hypodermic needle as figure below, (WHO guidelines on drawing blood, p.23). Lastly, the sample was put in the anti-coagulant tube.

3.4.4 Blood Analysis

This is an important part in analyzing the blood. The materials was used in blood analysis are as follow:

I. The centrifuge equipment EBA-8 "S" Hettich.

II. Electrospectrophotoetre "Cobas Mira"

III. "Cuvette" 1.0cm.

IV. 1 unit kit review of liver enzymes AST, ALT and GGT

V. Micro pipette

VI. Distill water.

Firstly, electrospectrophotometre were calibrated to reduce the error while sampling occurs. Then, 2 units for control sample cuvette was provided. After that, 1.5mL reagent was dissolved into each cuvette and arranged at 37°C. The wavelength was selected at 405nm/340nm and tools will be zero spectrophotometer at "0" using distilled water. After that, both sample was putting in instrument and taking the reading. At intervals within 2 minutes the controls was added again 0.025ml sample to each cuvette and make observations on the absopsi while maintaining the same temperature. Finally, he reading absopsi 1 minute after adding sample or control was measured and record. If the average readings exceed the 0.31 AU / min then re-melted with the "saline". The result that was obtained was multiplied with the factor which is 1072. All tools specification electrospectrophotometre are shown in table below

Table 3.2: Specification of electrospectrophotoetre.

Specification	Reading
temperature	37°C
wavelength range	340nm/ 406nm
Absobsi range	0-2AU
Cuvette pathlength	1.0cm
Reagen volume	2.0mL
Sample volume	0.2mL
Lag phase	1.0 minute

After making a set of parameters and measures for the experimental blood samples continue to be conducted, the analysis was obtained from the automatic electrospectrophotometre tools. Finally, all reading was recorded at all respondents.

3.4.6 Data Analysis

All the data analysis was analyzed by using the statistical analysis by performing SPSS 18.0 (Statistical Package for Social Science) and Microsoft Excel 2007 for Window Seven. Descriptive statistic including mean, median, and standard deviation was run to know and to analyze the distribution of all variable include in this study

Descriptive statistic was 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 analysis was used to get percentage, means, and standard deviation, ranges, percentiles, maximum and minimum values.

The normality test in this study was 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 was used to analyse data. For example, the first and second hypothesis T-Test statistical analysis will be used if the data is normally distributed while the Mann Whitney U Test was used if the data not normally distributed.

Another level or stage is bivariate. In this stage, Pearson Correlation was used to looking the relationship between levels of liver enzyme at exposed group with the time of exposure to the pesticide and also association between dermal scoring and liver enzyme level. Moreover, chi-square, x^2 was used to determine the significant differences on liver enzyme level between two groups of respondent.

3.4.7 Quality control.

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

3.4.8 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 was conducted.

1. Brief explanation about the whole of the study activities involved before the data collection carried out was given to respondent.

2. The purpose of the visual scoring system and fluorescent tracers take place was explained to the paddy farmers.
3. The objective and the ways to answer the contact dermatitis questionnaire were explained to the paddy farmers.

CHAPTER 4

RESULT

4.1 Study Location

This study has been 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 (Paramananthan, 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)

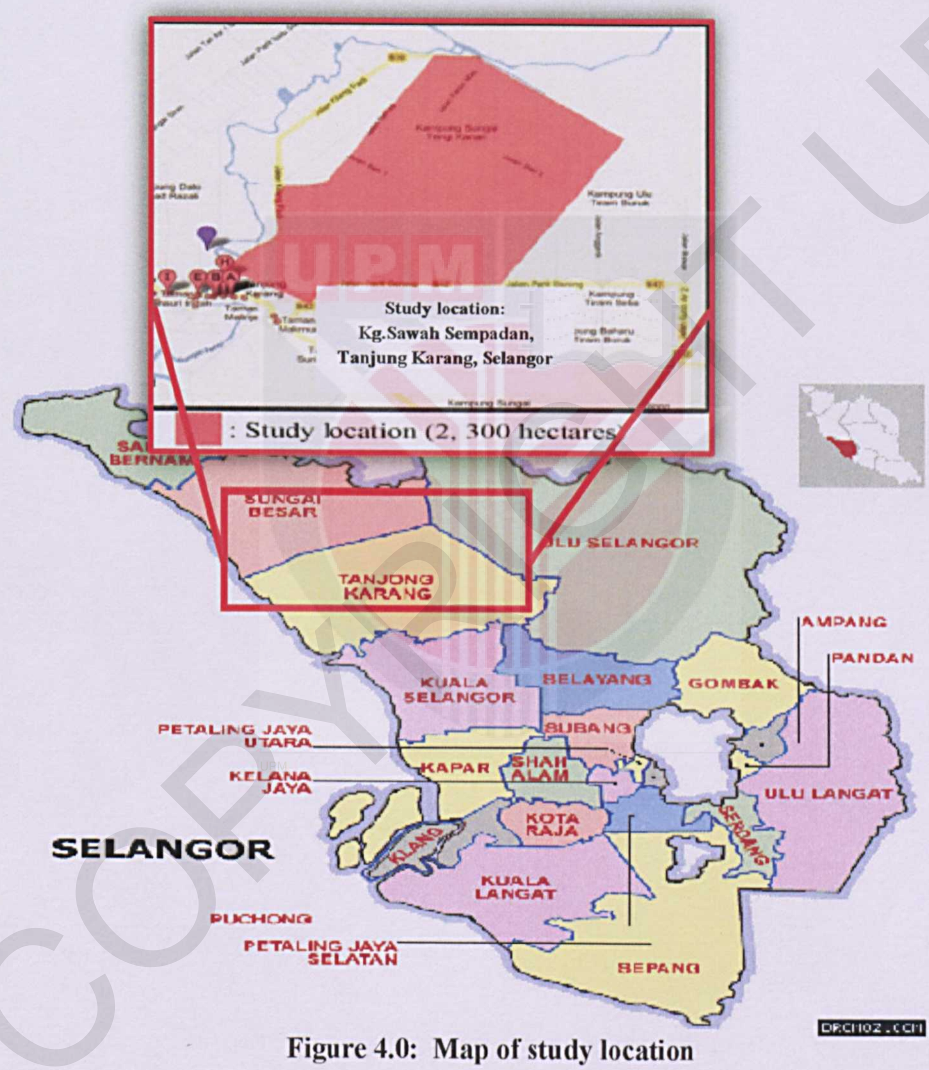

Figure 4.0: Map of study location

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.

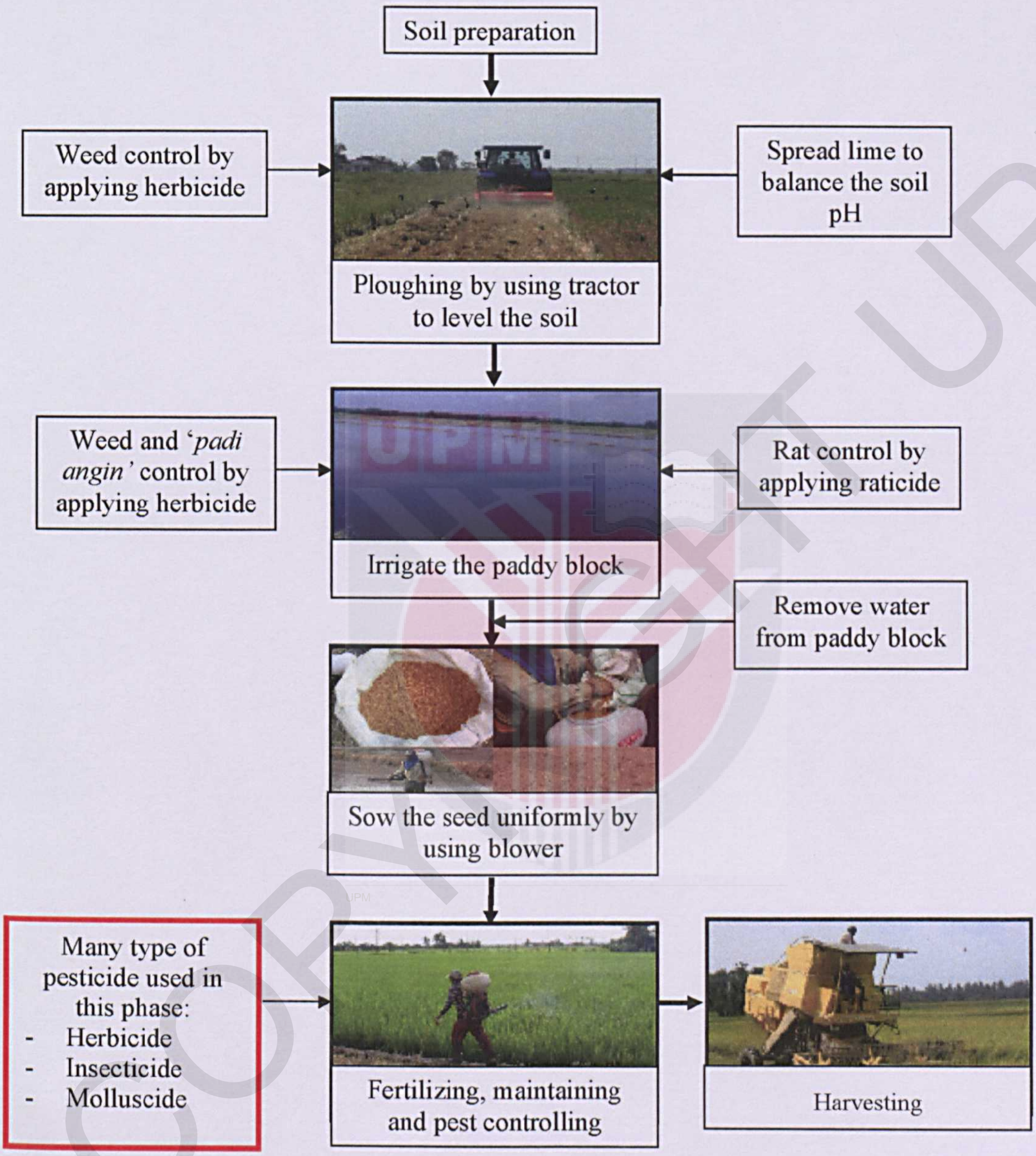

Figure 4.1: Process of Paddy Cultivation

4.3 Background

This study aims to determine the association between liver enzyme level and exposure to herbicide via direct dermal contact

This study was conducted on 75 rice farmers that exposed to herbicide when they mixing, loading and spray the herbicide. From 75 rice farmers about 45(60%) was highly exposed, where the dermal scoring was 5 to 19.5. While, 30(40%) was low exposed to herbicide where the dermal scoring was 0.5 to 2.5 that obtained from Dermal Exposure Ranking Method (DREM) was quantified.

In overall, the study of effect of liver enzyme level has been done 100% at the workers that works as rice farmers from male and Malay workers. In this study also, the respondent was choose according to their job task which is mixing, loading and spraying the pesticide. The age of the respondent in this is study is between 20 years old to 60 years old and has employment's years between 1 years to 28 years in this field make.

4.4 Respondent Background

4.4.1 Socio-demographic among respondents

Table 4.0 has shows the socio-demographic of the respondents such as marital status, educational level, income salary in one month and work duration.

Table 4.0: Distribution of respondents according to Socio-demographic

Variables		Exposed (n=45)		Comparative (n=30)		Total (n=75)
		n (%)	*Mean(SD)*	*n (%)*	*Mean(SD)*	*n (%)*
Marital Status	Single	6(13.3)		10 (33.3)		16 (21.3)
	Married	38(84.4)		20 (66.7)		58 (77.3)
	Widower	1(2.2)		-		1 (1.3)
Educational Level	No Adducation	1 (2.2)		2 (6.7)		3 (4.0)
	Primary School	6 (13.3)		4 (13.3)		10 (13.3)
	Secondary School	37 (82.2)		23 (76.7)		60 (80)
	Certificate Level	-		1 (3.3)		1 (1.3)
	Degree	1 (2.2)		-		1 (1.3)
Income salary (1 month)	RM0.00-RM1000	27 (60.0)		23 (76.7)		50 (66.7)
	RM1000-RM2000	12 (26.7)		7 (23.3)		19 (25.3)
	RM2000-RM3000	3 (6.7)		-		3 (4.0)
	>RM3000	3 (6.7)		-		3 (4.0)
Work Duration	Day		4.58(1.288)		4.80(1.297)	
	Week		5.29(1.487)		4.90(1.729)	
	Years		11.62(7.596)		10.13(6.852)	

Table 4.1 has shows the comparison of the age, cigarettes number in one day, smoking status, smoking during working and bathing before and after working of farmers between two groups in this study. The Chi-square test was conducted by comparing the smoking status, smoking during working and bathing before and after working between groups in this study. The Man-Whitney U was conducted for comparing age, body mass index (BMI) and cigarettes number in one day. The result showed, there is no significant difference ($p>0.05$) of age, body mass index (BMI), cigarettes number in one day smoking status, smoking during working and bathing after working, between exposed and comparative groups of the study. The only significant different ($p<0.05$) was showed for bathing before working.

Table 4.1: Prevalence of age, BMI, smoking status and personal hygiene of farmers. (n=75)

Variable	Exposed (n=45)				Comparative (n=30)				X^2	Z	p
	n (%)	*Median (IQR)*	*Range*	*Mean Rank*	*n (%)*	*Median (IQR)*	*Range*	*Mean Rank*			
Age		40 (20)	47	18-65		38.50 (22)	46	18-57		-0.601	0.548
BMI		24.295 (3.70)	14.15	17.10-31.25		22.168 (4.61)	13.20	18.05-31.25		-1.774	0.076
Cigarettes number (one day)		10 (1)	36	0-36		10 (1)	20	0-20		-0.050	0.960
Smoking	30 (66.7)				19 (63.3)						0.808
Smoking during working #	9(20)				7(15.56)						0.778
Bathing Before working	44(97.78)				25(83.33)				5.103		*0.024
Bathing After Working	43(95.56)				28(93.33)				0.176		0.675

** Significant at p<0.05*
 # Fisher Exact Test

4.2 Prevalence of work information among farmers.

Table 4.2 shows the types of pesticide was used among farmers, most were insecticides (95.55%) followed by herbicide (91.11%) and molluscide (64.44%).While for the comparative group, 93.33% of the respondent used insecticide, 86.67% used herbicide and only 56.67% used molluscide for their crops. All the respondents for exposed and control group perform mixing and spraying of pesticide activities. Most respondents were used knapsack spraying (90.67%) follow with manual or mist spraying (33.33%) and pressure spraying (5.33%).

Table 4.2: Prevalence of work information of farmers between two groups.

Variables	Exposed (n=45)	Comparative (n=30)	Total (n=75)
	n(%)	*n(%)*	*n(%)*
Type of pesticides			
Insecticide	43(95.55)	28(93.33)	71(94.67)
Molluscide	29(64.44)	17(56.67)	46(61.33)
Herbicides	41(91.11)	26(86.67)	67(89.33)
Type of activities			
Mixing	45(100)	30(100)	75(100)
Spraying	45(100)	30(100)	75(100)
Fertilizing	42(93.33)	29(96.67)	71(94.67)
Ploughing	4(8.89)	5(16.67)	9(12)
Harvesting	3(6.67)	2(6.67)	5(6.67)
Type of spraying equipment			
Knapsack sprayer	42(93.22)	26(86.67)	68(90,67)
Manual/Mist blower	14(31.11)	11(36.67)	25(33.33)
Pressure sprayer	2(4.44)	2(6.67)	4(5.33)

4.5 Personal Protective Equipments among Respondents

Comparison of Personal Protective Equipment scoring showed in table 4.3 there is no significant ($p>0.05$) between two groups. Information of wearing personal protective equipment (PPE) among exposed and comparative group during their work activities are showed in the Table 4.4. For the exposed group, most of the farmers wear long pants (100%), long sleeve (93.33%), cover mask (91.11%), hat/cap (77.78%) and boots (73.33%) however; only (15.56%) wore water-proof clothes.

Table 4.3: Comparison of Personal Protective Equipment's Score between Two Groups.

	Exposed (n=45)			**Comparative (n=30)**			**Z**	**p**
	Median (IQR)	***Range***	***Mean Rank***	***Median (IQR)***	***Range***	***Mean Rank***		
PPE Scoring	3.000 (2.00)	5.000	0-5	3.500 (1.00)	4.000	1.5	-0.292	0.770

Table 4.4: Prevalence of Personal Protective Equipment (PPE) Used Among the Farmers

Variables	**Exposed (n=45)**	**Comparative (n=30)**	**Total (n=75)**
	n(%)	**n(%)**	**n(%)**
Rubber boots	33(73.33)	22(73.33)	55(73.33)
Water-proof clothes	7(15.56)	4(13.33)	11(14.67)
Gloves	17(37.78)	10(33.33)	27(36)
Eye protector	19(42.22)	11(36.67)	30(40)
Mask	41(91.11)	25(83.33)	66(88)
Hat / cap	35(77.78)	26(86.67)	61(81.33)
Long sleeves	42(93.33)	28(93.33)	70(93.33)
Long Pents	45(100)	29(96.67)	74(98.67)

4.6 Prevalence of Dermal Scoring From Dermal Exposure Ranking Method among Respondents

This study was conducted on 75 rice farmers that exposed to herbicide when they mixing, loading and spray the herbicide. From 75 rice farmers about 45(60%) was highly exposed where the dermal scoring was 5 to 19.5. While, 30(40%) was low exposed to herbicide where the dermal scoring was 0.5 to 2.5 that obtained from Dermal Exposure Ranking Method (DREM) as in Figure 4.2. While, Figure 4.3 has shows a distribution of dermal scoring result from Dermal Exposure Ranking Method DREM.

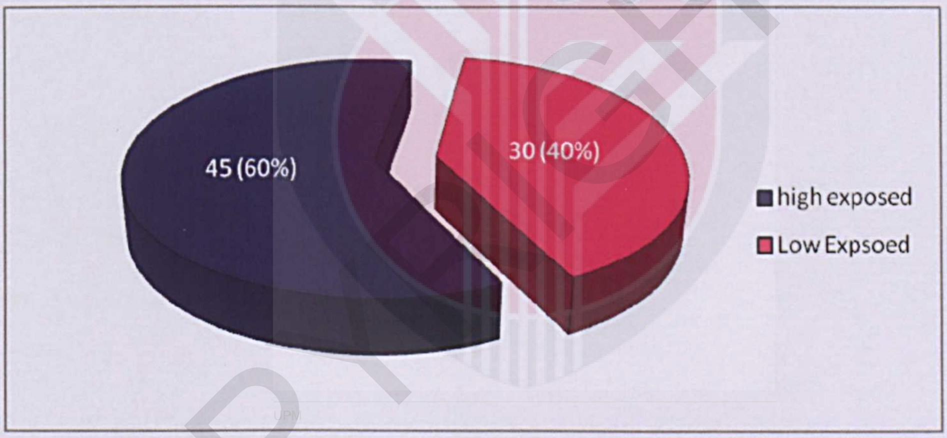

Figure 4.2: Dermal Exposure to Herbicide

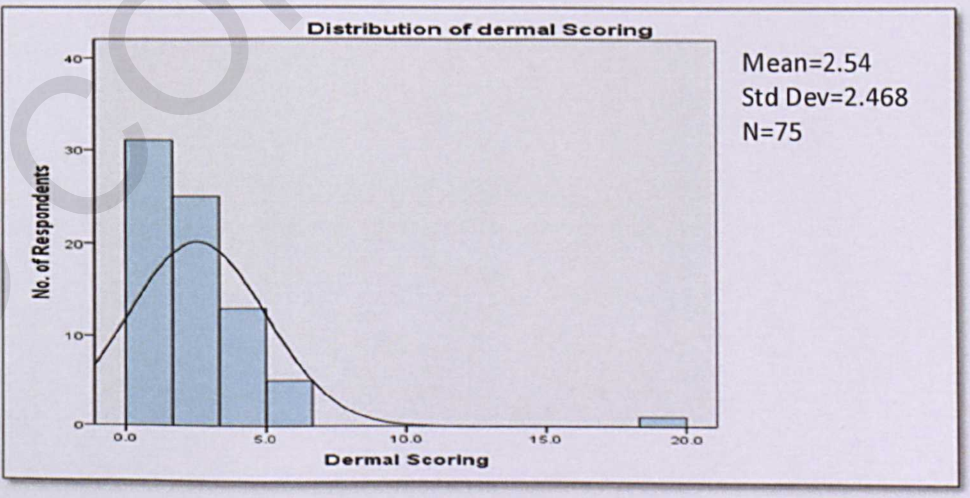

Figure 4.3: Distribution Dermal Scoring from DREM

4.7 Prevalence of Body Part Exposed To Herbicide during Work Activities

Percentages of the exposed body part of the paddy farmers by using fluorescent tracers is shown in the figure 4.4 below, the least and most of body part exposed were identified. Most of the pesticide exposure can be seen on right of the finger (36.9%) of the farmers; thorax back (35.2%) and right palm (25.4%) are the most body part exposed to the pesticide while spraying activity.

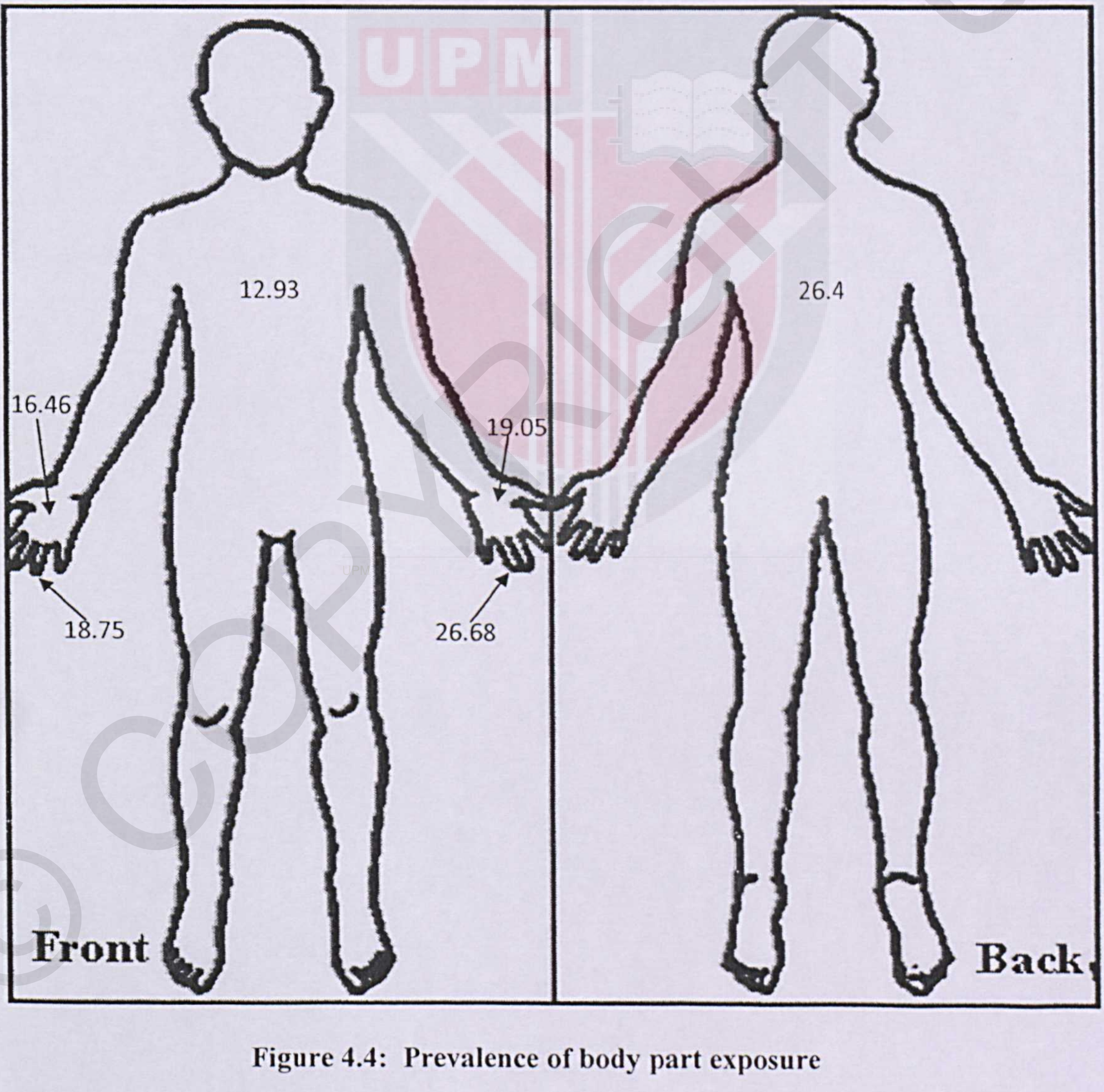

Figure 4.4: Prevalence of body part exposure

4.8 Comparison of liver enzyme level between two groups.

Normality tests which are kolmogrove-Smirnove test and Shapiro-Wilk test was conducted to look the distribution of liver enzyme level whether normal distributed or not normal distributed. After normality test done in this study, it show that the liver enzyme level in both groups are not normally distributed where p<0.05. The normality test is very important in indentifying suitable test for another hypothesis.

The third objective of this study is to compare the liver enzyme level (GGT, ALT and AST) between exposed and comparative group and the result in the table 4.5 below. According to the Man-Whitney U test, it show that the all enzyme (GGT, ALT and AST) have significant difference (p<0.001) between exposed and comparative groups.

Table 4.5: Comparison of liver enzyme GGT, ALT and AST

	Exposed (n=45)			Comparative (n=30)				
	Median (IQR)	Range	Mean Rank	Median (IQR)	Range	Mean Rank	Z	p
GGT	56.31 (16)	15-91	50.36	26.76 (11)	16-60	19.47	-6.021	**<0.001
ALT	55.89 (16)	25-72	51.70	30.87 (10)	16-50	17.45	-6.678	**<0.001
AST	57.52 (17)	30-100	50.98	27.40 (7)	20-56	18.53	-6.325	**<0.001

***** Significant at p<0.001.***

4.9 Comparison of Health Complaint between Two Groups.

The fourth objective is to compare the health problems between exposed and comparative groups. According to the table 4.6, eye itchiness, sweating, headache, nausea and skin itchiness was studied. Moreover, in this study also, the comparison of health problems among two groups of respondent has done before working, during working and after working. Chi-square analysis showed a significant difference ($P < 0.05$) between the exposed and comparative groups for selected variables on such health effects as eye itchiness after working (OR=1.529), (CI (95%)=0.591-3.961), nausea during working (OR=5.125), (CI (95%)=1.402-18.374) and skin itchiness (OR=4.048), (CI (95%)=2.113-17.308) . The results for perceived health effect variables showed a higher percentage of occurrences for the exposed group than for the non-exposed group. However, no significant difference ($P > 0.05$) was found with regards to health symptoms related to other perceived health effects. In skin symptoms it has been divided into skin itchiness, skin rash, skin redness, skin blister, skin scaling, skin crusty and pain. From the chi-square analysis only two skin symptoms shows a significant different ($p<0.001$) which are skin itchiness (OR=0.024), (CI (95%) =0.006-0.092) and skin redness (OR=0.047), (CI (95%) =0.014-0.156). Table 4.7 shows the prevalence of skin symptoms among two groups of farmers.

Table 4.6: Perceived Health Symptoms among Paddy Farmers.

Variables		Exposed (n=45)	Comparative (n=30)	Total (n=75)	x^2	p	OR	CI (95%)
		n (%)	*n (%)*	*n (%)*				
Watery Eyes	*#Before Working*	1 (2.2)	1 (3.3)	2 (2.67)		1.000		
	During Working	31 (68.89)	16 (53.33)	47 (62.67)	0.320	0.572		
	#After Working	25 (55.6)	4 (13.3)	29 (38.67)		*0.036	1.529	0.591-3.961
Sweating	*#Before Working*	5 (11.1)	1 (3.3)	6 (8)		0.392		
	During Working	21 (46.7)	6 (20)	27 (36)	0.000	1.000		
	#After Working	5 (11.1)	5 (16.7)	10 (13.33)		0.508		
Headache	*#Before Working*	2 (4.4)	1 (3.3)	3 (4)		1.000		
	During Working	16 (35.6)	12 (64.4)	28 (37.33)	0.152	0.697		
	#After Working	5 (11.1)	6 (20.0)	11 (14.67)		0.330		
Nausea	*#Before Working*	1 (2.2)	3 (10.0)	4 (5.33)		0.295		
	During Working	40 (88.9)	9 (30.0)	(49) 65.33	4.230	*0.040	5.125	1.402-18.374
	#After Working	4 (8.9)	4 (13.3)	8 (10.67)		0.706		
Skin Symptoms		19 (42.2)	5 (16.7)	24(32)	5.402	*0.020	4.048	2.113-17.308

** Significant at p<0.005*
 # Fisher Exact Test

Table 4.7: **Prevalence of Skin Symptoms among Paddy Farmers.**

Skin symptoms	Exposed (n=45) n(%)	Comparative (n=30) n(%)	Total (n=75) n(%)	x^2	p	OR	CI(95%)
Itchy	39 (86.67)	4 (13.33)	43 (57.33)	39.571	**<0.001	0.024	0.006-0.092
#Rash	6 (13.33)	4 (13.33)	10 (13.33)		1.000		
Redness	39 (86.67)	7 (23.33)	46 (61.33)	30.444	**<0.001	0.047	0.014-0.156
#Blister	3 (6.67)	0 (0)	3 (4)		0.270		
#Scaling	0 (0)	1 (3.33)	1 (1.33)		0.400		
#Crusty	0(0)	1 (3.33)	1 (1.33)		0.400		
#Pain	1 (2.22)	1 (3.33)	2 (2.67)		1.000		

**** Significant at p<0.001**
 # Fisher's Exact Test

4.10 Correlation between Liver Enzyme Level and Duration of Exposure

For the fifth objective is to look the association between liver enzyme level and duration of exposure in one day, one week and duration of working in years between exposed and comparative group. Table 4.8 have used Spearman Correlation test, it show that is no significant difference (p>0.05) between exposed and comparative groups. Thus, there is no association relationship between liver enzyme level and duration of exposure.

Table 4.8: Correlation between Liver Enzymes Level and Duration of Exposure.

		Exposed (n=45)		Comparative (n=30)	
	Duration of Exposure	**r**	**p**	**r**	**p**
GGT Enzyme	**Day**	0.094	0.538	0.229	0.223
	Week	0.188	0.215	0.231	0.219
	Years (Employment Years)	0.107	0.485	0007	0.970
ALT Enzyme	**Day**	0.096	0.531	0.133	0.483
	Week	0.146	0.337	0.026	0.891
	Years (Employment Years)	0.156	0.308	0.046	0.808
AST Enzyme	**Day**	0.177	0.244	0.108	0.569
	Week	0.187	0.219	0.036	0.850
	Years (Employment Years)	0.081	0.597	0.187	0.322

4.11 Correlation between liver enzyme level and dermal scoring from Dermal Exposure Ranking Method (DERM).

For the sixth objective is to determine the association between skin exposures with liver enzyme level among the respondents. Table 4.9 have used Spearman Correlation test, it show that is no significant difference ($p>0.05$) between exposed and comparative groups. Thus, there is no association relationship between skin exposures with liver enzyme level between exposed and comparative groups.

Table 4.9: Correlation between Liver Enzymes Level and dermal scoring

	Dermal Exposure Ranking Method (DREM) Scoring			
	Exposed (n=45)		Comparative (n=30)	
	r	p	r	p
GGT Enzyme	0.038	0.805	-0.249	0.185
ALT Enzyme	-0.219	0.149	0.226	0.230
AST Enzyme	0.124	0.417	-0.021	0.913

4.12 Selected Variables that Influence Health Complain among Exposed Group

Multiple Linear Regression analysis is used to identify independent variable which significantly influenced the health complain that have significant different ($p<0.05$) among exposed group and comparative groups. The chi-square test was conducted as table 4.8 and only watery eyes after working, nausea during working and skin symptoms was show a significant different ($p<0.05$).

4.12.0 The factors associated with watery eyes after working due to herbicide exposure among paddy farmers

There was no significant correlation between selected variable and watery eye after working. Table 4.10 shows the factors associated with watery eye after working to herbicides among the exposure paddy farmers.

Table 4.10: Selected variables influence watery eyes among exposed group (n=45)

Independent Variable	T	p	F	p
Body Mass Index	-0.052	0.903		
Smoking habit	-0.095	0.678		
smoking frequency (per day)	-0.019	0.123		
Smoking during working	-0.171	0.342		
Personal hygiene				
Bathing before working	-0.513	0.206		
Bathing after working	-0.377	0.193		
Working duration				
Day	-0.007	0.890	1.148	0.341
Week	-0.038	0.389		
Years (Employment Years)	0.004	0.677		
Type of spraying equipment				
Manual spraying	-0.220	0.163		
Pressure Spraying	0.639	0.098		
Motorize Spraying	0.561	0.154		
Spray time				
Morning	-0.038	0.683		
Evening	0.138	0.293		
PPE Scoring	0.109	0.111		

4.12.1 The factors associated with nausea during working due to herbicide exposure among paddy farmers

There was no significant correlation with nausea during working. Table 4.11 shows the factors associated with nausea during working to herbicides among the paddy farmers.

Table 4.11: Selected Variables Influence Nausea among Exposed Group (n=45)

Independent Variable	T	p	F	p
Body Mass Index	-0.173	0.075		
Smoking habit	-0.063	0.738		
smoking frequency (per day)	-0.002	0.847		
Smoking during working	-0.057	0.693		
Personal hygiene				
Bathing before working	-0.470	0.151		
Bathing after working	0.066	0.776		
Working duration				
Day	0.082	0.059	0.971	0.497
Week	-0.007	0.851		
Years (Employment Years)	0.002	0.798		
Type of spraying equipment				
Manual spraying	-0.084	0.507		
Pressure Spraying	0.343	0.266		
Motorize Spraying	0.583	0.068		
Spray time				
Morning	-0.043	0.567		
Evening	0.005	0.963		
PPE Scoring	0.051	0.353		

4.12.2 The factors associated with skin symptoms during working due to herbicide exposure among paddy farmers

There was no significant correlation with skin symptoms. Table 4.12 shows the factors associated with skin symptoms to herbicides among the paddy farmers.

Table 4.12: Selected Variables Influence Skin Symptoms among Exposed Group (n=45)

Independent Variable	T	p	F	p
Body Mass Index	0.018	0.894		
Smoking habit	0.151	0.600		
smoking frequency (per day)	-0.021	0.147		
Smoking during working	-0.076	0.716		
Personal hygiene				
Bathing before working	0.416	0.455		
Bathing after working	0.312	0.396		
Working duration				
Day	-0.067	0.288	0.509	0.914
Week	0.047	0.429		
Years (Employment Years)	0.004	0.740		
Type of spraying equipment				
Manual spraying	-0.137	0.492		
Pressure Spraying	-0.078	0.841		
Motorize Spraying	0.038	0.925		
Spray time				
Morning	-0.096	0.515		
Evening	-0.032	0.867		
PPE Scoring	0.013	0.868		

4.13 Selected Variables Influence Skin Symptoms among Exposed Group

Multiple Linear Regression analysis is used to identify independent variable which significantly influenced the skin symptoms that have significant different ($p<0.005$) among exposed group and comparative groups. The chi-square test was conducted as table 4.9 and only skin itchiness and skin redness was show a significant different ($p<0.005$).

4.13.0 The factors associated with itchiness due to herbicide exposure among paddy farmers

There was no significant correlation with itchiness. Table 4.13 shows the factors associated with itchiness to herbicides among the paddy farmers.

Table 4.13: Selected variables influence itchiness among exposed group (n=45)

Independent Variable	T	p	F	p
BMI	0.130	0.314		
Smoking habit	-0.138	0.596		
smoking frequency (per day)	-0.005	0.684		
Smoking during working	-0.246	0.210		
Personal hygiene				
Bathing before working	-0.175	0.691		
Bathing after working	-0.265	0.392		
Working duration				
Years (Employment Years)	-0.005	0.520		
Week	-0.138	0.914		
Day	0.038	0.485	0.875	0.609
Activities				
Mixing	0.520	0.081		
Spraying	0.177	0.524		
Type of spraying equipment				
Manual spraying	-0.042	0.798		
Pressure Spraying	-0.113	0.778		
Motorize Spraying	0.024	0.953		
Spray time				
Morning	-0.153	0.128		
Evening	0.070	0.636		
PPE Scoring	0.000	0.995		

4.13.1 The selected variables associated with redness due to herbicide exposure among paddy farmers

There was no significant correlation with redness. Table 4.14 shows the factors associated with redness to herbicides among the paddy farmers

Table 4.14: Selected variables influence redness among exposed group (n=45)

Variables	T	p	F	p
BMI	0.295	0.012		
Smoking habit	0.012	0.957		
smoking frequency (per day)	0.001	0.899		
Smoking during working				
Personal hygiene	-0.262	0.129		
Bathing before working	-0.003	0.995		
Bathing after working	0.195	0.476		
Working duration				
Years (Employment Years)	-0.002	0.819		
Week	-0.022	0.596		
Day	-0.097	0.046	1.703	0.074
Activities				
Mixing	0.175	0.480		
Spraying	-0.247	0.244		
Type of spraying equipment				
Manual spraying	-0.140	0.343		
Pressure Spraying	0.222	0.533		
Motorize Spraying	0.093	0.800		
Spray time				
Morning	-0.287	0.002		
Evening	0.033	0.789		
PPE Scoring	0.009	0.884		

4.14 Selected Variables Influence Dermal Scoring From DERM among Exposed Group

Working at evening has showed a significant correlation with dermal scoring from Dermal Ranking Exposure Method. Table 4.15 shows the factors associated with dermal scoring from Dermal Exposure Ranking Method to herbicides among the paddy farmers.

Table 4.15: Selected Variables Influence Dermal Scoring among Exposed Group (n=45)

Variables	T	p	F	p
BMI	0.128	0.293		
Smoking habit	0.032	0.895		
smoking frequency (per day)	-0.001	0.951		
Smoking during working	-0.109	0.552		
Personal hygiene				
Bathing before working	0.037	0.929		
Bathing after working	0.236	0.422		
Working duration				
Years(Employment Years)	0.002	0.871		
Week	0.046	0.311		
Day	-0.097	0.062	1.093	0.306
Activities				
Mixing	0.037	0.889		
Spraying	0.044	0.846		
Type of spraying equipment				
Manual spraying	0.080	0.613		
Pressure Spraying	-0.015	0.968		
Motorize Spraying	0.043	0.912		
Spray time				
Morning	0.107	0.413		
Evening	-0.296	*0.004		
PPE Scoring	-0.049	0.469		

**** Significant at p< 0.05***

4.15 Selected Variables Influence Increasing Liver Enzyme Level among Exposed Group

Multiple Linear Regression analysis is used to identify independent variable which significantly influenced the increasing liver enzyme level that have significant different ($p<0.001$) among exposed group and comparative groups. The Man-Whitney U test was conducted as table 4.7 and all liver enzymes (GGT, ALT and AST) level shows a significant difference ($p<0.001$) between two groups of study.

4.15.0 Selected Variables Influence Increasing GGT Enzyme Level among Exposed Group (n=45)

Variables such as motorize sprayer and working in evening had showed a significant correlation with GGT enzyme level. Table 4.16 shows the factors associated with GGT enzyme level to herbicides among the paddy farmers.

Table 4.16: Selected Variables Influence GGT enzyme among Exposed Group (n=45)

Variables	T	p	F	p
BMI	0.142	0.227		
Smoking habit	-0.280	0.224		
smoking frequency (per day)	0.003	0.809		
Smoking during working	-0.314	0.078		
Personal hygiene				
Bathing before working	-0.027	0.946		
Bathing after working	0.229	0.417		
Working duration				
Years (Employment Years)	0.003	0.739		
Week	0.048	0.265		
Day	-0.070	0.159	1.706	0.073
Activities				
Mixing	-0.006	0.981		
Spraying	-0.140	0.520		
Type of spraying equipment				
Manual spraying	0.219	0.152		
Pressure Spraying	0.584	0.116		
Motorize Spraying	0.672	*0.044		
Spray time				
Morning	-0.057	0.653		
Evening	0.304	*0.001		
PPE Scoring	0.059	0.371		

Significant at p< 0.05

4.15.1 Selected Variables Influence Increasing ALT Enzyme Level among Exposed Group (n=45)

Total working in day, motorize sprayer and working at evening had shows a significant correlation with ALT enzyme level. Table 4.17 shows the factors associated with ALT enzyme level to herbicides among the paddy farmers.

Table 4.17: Selected Variables Influence ALT enzyme among Exposed Group (n=45)

Variables	T	p	F	p
BMI	6.619	0.092		
Smoking habit	1.257	0.869		
smoking frequency (per day)	-0.173	0.657		
Smoking during working	-2.434	0.676		
Personal hygiene				
Bathing before working	7.427	0.581		
Bathing after working	2.271	0.808		
Working duration				
Years (Employment Years)	-0.235	0.440		
Week	1.070	0.454		
Day	-4.062	*0.015		
Activities			1.487	0.142
Mixing	4.962	0.558		
Spraying	0.900	0.901		
Type of spraying equipment				
Manual spraying	1.941	0.699		
Pressure Spraying	22.722	0.074		
Motorize Spraying	27.079	*0.030		
Spray time				
Morning	-4.985	0.236		
Evening	7.608	*0.014		
PPE	-1.026	0.636		

**** Significant at p< 0.05***

4.15.2 Selected Variables Influence Increasing AST Enzyme Level among Exposed Group (n=45)

Only working in evening has shows a significant correlation with AST enzyme level. Table 4.18 shows the factors associated with AST enzyme level to herbicides among the paddy farmers.

Table 4.18: Selected Variables Influence AST enzyme among Exposed Group (N=45)

Variables	T	p	F	p
BMI	0.062	0.600		
Smoking habit	0.367	0.118		
smoking frequency (per day)	-0.021	0.078		
Smoking during working	-0.113	0.527		
Personal hygiene				
Bathing before working	-0.102	0.804		
Bathing after working	0.096	0.737		
Working duration				
Years (Employment Years)	0.011	0.219		
Week	0.063	0.151		
Day	-0.063	0.209	1.453	0.152
Activities				
Mixing	0.309	0.234		
Spraying	0.050	0.822		
Type of spraying equipment	0.011	0.941		
Manual spraying				
Pressure Spraying	0.546	0.157		
Motorize Spraying	0.551	0.143		
Spray time				
Morning	-0.179	0.165		
Evening	0.236	*0.013		
PPE	0.023	0.728		

***** *Significant at* $p< 0.05$

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Discussion

This study aims to determine the association between liver enzyme level and exposure to herbicide via direct contact which is dermal exposure.

This study was conducted on 75 paddy field farmers that exposed to pesticide when they mixing, loading and spray the pesticide. While for the control group was conducted on 30 farmers that have very less exposure to pesticide according to the dermal scoring from Dermal Exposure Ranking Method (DREM).

In overall, the study of effect of liver enzyme level has been done 100% at the workers that works as rice farmers from male and Malay workers. In this study also, the respondent was choose according to their job task which is mixing, loading and spraying the pesticide. Furthermore, the age of the respondent in this is study is between 20 years old to 60 years old. Not only was that, to avoid the confounder in this study, only Malay workers choose. Finally, according to their work duration which is between 1 years to 28 years in this field make me interested to identify the association between dermal exposure and liver enzyme level.

5.1.1 Respondents Comparison and Matching Of the Study.

Variables such as age, material status, educational level, income in one month, smoking status and number of cigarette in one day are the variables that which has been studied. However, for matching method only age, smoking status and number of cigarette in one day has been studied to looking their comparison between two groups. While, other variables such as material status, income in one month and educational level are only study their prevalence. From the t-test for age of respondents, can be prove that there is no significant difference between the mean of the study. Meanwhile, the Fisher Exact test for respondents smoking status, also show no significant difference between the two groups in this study. Finally, the Man-Whitney U test for comparison number of cigarette in one day also shows no significant differences between two groups of study. So, this shows a matching method is done to prevent confounder factor that can influence the result can be well control in this study.

According to Osman (2000), matching method is one of the important methods that used in control the confounder factor that can influence the result of the study. According to him also, usually the variables need to be matching are age, gender, economic status. These variables are able to influence the prognosis of the diseases. John *et al.*, (2002) of the opinion that the variables such as age, ethnic and gender are the variables need to be control if in that study have control or comparative groups. According to him also, it is because when a large population sample is used, a method of appointment of adjustment taken into account to distinguish the results of the study variables are important.

According to the information in the facts, this study also takes into account the variables that will influence the result of this study. Therefore, matching method was conducted at the earlier stage before the study conducted to make sure the certified result are getting. Not only that, this matching method was conducted before this in several studied such as study about health evaluating by Poland *et at.*, (2001) on the workers that work at production plant of 2,4,5-D (2,4,5-dichlorophenocsiasetic acid) and 2,4,5-T (2,4,5-trichlorophenocsiasetic acid) was used matching method into several variables such as smoking, alcohol intake and clinical background to avoid confounder factor. Other study that also used matching method is studied about level of organochlorine in blood by Radomski *et al.*, (2004) was conducting matching method to age, weight and gender of respondents.

5.1.2 Prevalence of body part exposed to herbicide during work activities

The first objective is to identify the main body part that highly exposed to the herbicide during work activities. About 25 body part of respondents was observed between both groups of study. The 25 distribution of body parts are based on the studied that was done by Aurora Aragon *et al.*, (2005) which is assessment of dermal pesticide exposure with fluorescent tracer. From the finding, it shows that most of the body part that highly exposed to the herbicide is right finger (36.9%), than follow with thorax back (35.2%) and right palm (25.4%). These three body part are highly exposed to the herbicide during working activities.

According to respondents' job tasks which are mixing, holding and spraying the herbicide with motorized sprayers make respondent are exposed with herbicide directly into the skin. Moreover, the similar finding was done by other study which is a study on inhalation and dermal exposure to 2, 4-D and paraquat among Malaysian paddy farmers by Mohd Rafee *et al.*, (2011) where most respondents using motorized sprayers showed higher mean concentration of exposure to both herbicides which are paraquat ant 2, 4-D than those using manual sprayers.

Besides, from the finding also showed that right finger and right palm are highly exposed to the herbicide because most of the respondents are right handed. Therefore, right finger and right palm are the body part that highly exposed to herbicide which is 36.9% for right finger and 25.4% for right palm. On the other hand, thorax back also shows the high percentage which is 35.2%. This is due to the ways of holding motorized sprayers that can contribute the herbicide to come out from the container of motorized sprayers. Therefore, the leakage of motorized sprayer also played important role in contributing the high exposed to herbicide.

5.1.3 Comparison liver enzyme level.

The third objective is to compare the liver enzymes levels between exposed and comparative groups. The outcome from the analysis shows a significant difference ($p<0.001$) in mean of liver enzyme level (GGT, ALT and AST) between exposed and comparative group significant difference ($p<0.001$) in mean of liver enzyme level (GGT, ALT and AST) between control and comparative group. The outcome also shows that mean for liver enzyme level at exposed groups that highly exposed to the herbicide are higher compare to the comparative groups. Therefore, the outcome of this study is highly exposure to herbicide will lead to increase the liver enzyme level (GGT, ALT and AST).

This studied was demonstrated that herbicide affects liver metabolism. The leakage of certain intracellular enzymes suggested damage in hepatocytes. In this case, serum ALT and AST activities frequently served as an index of liver injury (Boer *et al.*, 2000; El *et al.*, 2002; Kuester *et al.*, 2002). Since AST and ALT leaking to serum is very sensitive marker of hepatocyte injury, increase in serum enzymes may occur due to minor liver injury in response to herbicide with low histological changes (Williams and Iatropoulos, 2002). While, elevated GGT levels indicate that something is damaging the liver with unknown factor. GGT is increased in most diseases that cause acute damage to the liver or bile ducts but is usually not helpful in distinguishing between different causes of liver damage.

This outcome is same as other previous study that also study about the association between organic compound and liver enzyme level. One of the study is health evaluation that was conducted by Polan *et al,.* (2001) found that liver enzyme such as ALT and AST are high at workers that that work production plant of 2,4,5-D (2,4,5-diklorophenoksiasetik acid) and 2,4,5-T (2,4,5-triklorophenoksiasetik acid). Besides that, it also shows a significant difference between exposed groups and control groups. Others study by Monesan *et al,.* (1998) found that patients who suffered with pesticide poisoning have higher level of ALT enzyme.

Furthermore, exposure to organic solvent also will affect the liver enzyme level. This can be proving by the studied that was conducted by Lunberg and Hakanson (2002). From their finding about 47 workers was working at pain industries has high level of liver enzyme level due to highly expose with organic solvent. Not only that, other study that was conducted by Jager (1970) and Darache (1977) was find that expose to pesticide will contribute to increasing of liver enzyme level.

Mohd Rafee *et al.*, (2011) studied about the long-term spraying activities of herbicide such as paraquat and 2,4-D were positively correlated with increasing levels of the liver enzyme. Studied has showed a significant difference ($P < 0.05$) of liver enzyme level between the exposed and non-exposed groups. The exposed group has a higher mean value of both liver enzymes compared to that of the non-exposed group. Both ALT and GGT liver enzymes in the exposed group were found to exceed the normal values of 0–48 IU/L and 30–60 IU/L, respectively A previous study was conducted by Azmi *et al*,. (2005) has also reported similar findings.

5.1.4 Comparison of health problems.

The forth objective is to compare the health complaint between exposed with comparative groups. From the finding, only several health problems shows a significant differences ($p<0.05$) such as eye itchiness during working, eye itchiness after working, nausea during working and skin itchiness between exposed and comparative groups. Other health problem did not show significant difference between exposed and comparative groups.

This finding was supported with other studies such as studied that was conducted by is Azizi (2000) and Ishaura (2001). They have determined the same health problems appear among respondents includes fatigue symptom. Itchiness skin problems that suffered by farmers are influenced by the type of pesticide that they used.

According to the Castro-Gutierrez *et al.*, (2005) chronic occupational paraquat exposure was said that paraquat was recognized as highly irritant pesticide, and one study reported skin rash or burn were detected among 53% applicators of backpack sprayers under conditions such as lacking in use of personal protective gear.

Other study also have prove that most farmers who highly exposed with pesticide was shows about 60 % have health problems relating to skin such as skin itchiness and dry skin, while 80% of respondents suffered with eyes problem such as eye itchiness and eyes redness. (Antle and Pingali, 1995)

Meanwhile, according to the studied that was done by the Weinbaum *et al.*, (2004) the health symptoms was classified into two parts which is local irritant and systemic. Local irritant was involving symptoms on eyes, skin and respiratory system. While, for systemic was involving health symptoms that is not specific such as diarrhea, nausea headache and sweating. The was conducted at 231 workers that are exposed to the pesticide from paraquat group which is 1,1-Dimethyl-4,4-Bipyrdylium Dichloride was found about 26% was suffer with problem skin symptoms and about 32% was suffer with problems eyes symptoms. Furthermore, all health problems that were issued have significant relationship with their job task such as mixing, holding and spraying. Therefore, failed to rejected second hypothesis which are the exposed groups have significantly higher health complaint than the comparative groups.

5.1.5 Correlation liver enzyme level and duration of exposure.

The fifth objective is to identify the association of liver enzyme level (GGT, ALT and AST) and duration of exposure with herbicide. From the finding, there is no significant correlation ($p>0.05$) between liver enzyme level (GGT, ALT and AST) and duration expose with herbicides during working activities. This finding was involved all enzyme that was interested in this study. Furthermore, duration that was studied are in hour, weekly and duration of work as rice farmer. This finding was same as previous study that was done to the workers that work as spraying the pesticide at pest by Azizi (2000). From his finding he was found that there is no significant relationship between liver enzyme level (GGT, ALT, ALP) and duration of exposure to pesticide. Other previous study that show a same finding is studied that was conducted by Ishaura, (2001) where there is no significant relationship between liver enzyme level (GGT, ALT, ALP, AST) and duration of exposure to pesticide. This studied was about association liver enzyme level and pesticide user among tobacco farmer at Kelantan.

This is because of the plantation activities of paddy that follow the season. After first season ending the farmers will getting a rest about 3 month until another season of plantation. The time table for plantation can be referring at appendix 4. During the rest time several farmer will continue used pesticide at palm estate. Therefore, this will influence the finding in this study. Besides that, all respondent not used or handling the herbicide at the same quantities and it is depending on the crops.

Human body are capable to redeveloped a cells that are already death or destroyed in one duration between several day and several week, and it is depends on the formulation of pesticide that was used. This factor also can take into account that can influence the finding of this study (William and Bursons, 2004).

5.1.6 Correlation liver enzyme level and dermal scoring from dermal Exposure Ranking Method (DREM).

The sixth objective is to identify the association of liver enzyme level (GGT, ALT and AST) and dermal scoring from Dermal Exposure Ranking Method (DREM) between exposed and comparative groups. From the finding, there is no significant correlation ($p>0.05$) between liver enzyme level (GGT, ALT and AST) and dermal scoring from Dermal Exposure Ranking Method (DREM) between exposed and comparative groups.

Dermal Exposure Ranking Method (DERM) by Blanco LE (2008) was used to evaluate the exposures of herbicide to the skin. the DERM are taking into account and assess by observation the others factor that influence the dermal contamination, such as the type of Transport process (T value) and he Area of body part exposed (A value).The T value is evaluated in terms of emission, deposition, and transfer of the pesticide to the skin or clothing of the paddy farmers. Then, the estimates of each factor are summed up, resulting in the assessment of potential dermal exposure. In addition, the type of clothing (C value), worn by the farmers during their work activities, is included as a protection factor. The product of this C value and the sum of the T and A value will provide the DERM score.

Therefore, the fourth hypothesis which is the skin exposure is significantly associated with liver enzyme levels among respondents are rejected due to skin exposure can give acute exposure while liver enzyme is one of the chronic effect after prolong exposed with herbicide.

5.1.7 Factors Associated With Health Complain among Exposed Paddy Farmers.

According to the result there is no selected factors that will influenced the Health complain which is watery eyes after working among exposed famers. However only certain variables had shows positive relationship for watery eyes after working which are employment years, motorize and pressure sprayer working at the evening and Personal Protective Equipments.

Healths complain for nausea during working also did not have selected factors that influenced the health complain. But, certain variables had show a positive relationship such as employment years, total working in day, bathe after working, pressure sprayer, motorize sprayer, Personal protective Equipments and working in evening had shows a positive relationship for nausea during working.

Furthermore, skin symptoms, did not have selected factors that influenced the health complain. Employment years, total working in week, bathe before and after working, motorize sprayer, Personal Protective Equipments and body mass index had shows a positive relationship for skin symptoms.

Therefore, there is no factors can influence the health complains among exposed paddy farmers. However, employment years, bathe after working, Personal Protective Equipment had shows a positive relationship between selected factor and health complain which are skin symptoms, nausea during working and watery eyes after working.

5.1.7 Factors Associated with Skin Symptoms among Exposed Paddy Farmers.

According to the result there were no selected factors that were influenced the skin symptoms which are itchiness among exposed famers. However only certain variables had shows positive relationship for itchiness such as total working in week, spraying activity, mixing activity, motorize sprayer, body mass index, personal protective equipment and working in evening

For skin problems, itchiness and redness also did not influenced the health complain. Moreover, there is no selected variables can influence the health problems for redness and itchiness.

Therefore, there is no factors can influenced the skin symptoms among exposed paddy farmers. However, according to the Mohd Rafee *et al.*, (2011) proper used of personal protective equipment can reduce the exposure to the herbicide and he was said that motorized sprayer can make the farmers highly exposed to the herbicide rather than manual sprayer.

5.1.7 Factors Associated with Liver Enzymes Level among Exposed Paddy Farmers.

Some selected variables can influence the level of liver enzyme. For GGT enzyme motorize sprayer and working in evening can influenced the level of liver enzyme. For ALT enzyme, total working in day, motorize sprayer and working in evening can influenced the ALT enzyme level. Lastly for the AST enzyme level only working in evening can influenced the AST enzyme level.

Therefore, motorize sprayer and working in evening are associated factor that influenced the liver enzymes (GGT, ALT, AST) level. According to the Rafee *et al.*, (2011) during evening, speed of wind are high than morning and it will influence the farmers exposed more to the herbicide due to the wind blow. According from him also respondents that was used motorized sprayers showed higher mean concentration of exposure to both herbicides than those using manual sprayers.

5.2 Conclusion.

As conclusion, there were significant different of liver enzyme (GGT, ALT and AST) between exposed groups and comparative groups. Farmers who spray the herbicide during evening by using motorize sprayer influenced the liver enzyme level (GGT enzyme, ALT enzyme and AST enzyme). Most of the body part that highly exposed to the herbicide is right finger (36.9%), than follow with thorax back (35.2%) and right palm (25.4%). This was due to, most of the respondents are right handed and the ways of holding motorized sprayers that can contribute the herbicide to come out from the container of motorized sprayers. The leakage of motorized sprayer also played important role in contributing the high exposed to herbicide. Besides, exposure to the herbicides also showed a significant relationship with health problems such as itchiness during working, eye itchiness after working, nausea during working and skin itchiness between exposed and comparative groups.

5.3 Recommendations

1. This study shows that pesticide exposure via the route of dermal has less potential to cause direct effect on the liver function among respondents. Nevertheless, the chronic effect of liver dysfunction might due to factors that have been accounted during quantification of dermal contamination at DERM score. Since dermal assessment through fluorescent tracer is only capable to justify the acute dermal exposure, further study is needed by considering dermal assessment into histology level or inhalation assessment to determine the main route of exposure which has potential to cause liver dysfunction due to pesticide usage among farmer.

2. Since dermal exposure and inhalation are the route of exposure to the herbicide in occupational setting, it is best if there have further study that evaluate which is the best route of entry of herbicide that can effected liver enzyme level.

3. Follow-up studies of farmers who have high enzyme levels should be conducted to identify the real factors that influence the outcome of this study.

4. A future study should consider factors such as exposure dose received by the consumer pesticides, area of paddy field and wind speed to get good results.

5. Parties such as the Farmers' Association should take care that the steps to provide further clarification on the impact of pesticides and the importance of using protective equipment.

6. To explain in detail to certain quarters on the good work practice that can use among farmers.

7. In addition, a review of the responsible party should be done so that the farmers received assistance in terms of appropriate personal protective equipment.

8. Encourage the farmers to further medical examination from a qualified medical center.

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APPENDIX 1

Respondent Information Sheet

PENERANGAN MAKLUMAT KEPADA RESPONDEN

Tajuk Kajian:
Perkaitan antara pendedahan racun makhluk perosak tanaman dengan kesan kesihatan di kalangan pesawah di Tanjung Karang, Selangor.

Pendahuluan:
Kajian ini bertujuan untuk menentukan kesan-kesan kesihatan pekerja disebabkan terdedah kepada racun perosak tanaman sepanjang kitaran pengeluaran padi. Seperti yang diketahui, pesawah padi sangat terdedah kepada pelbagai racun perosak tanaman kerana penanaman padi memerlukan pelbagai jenis racun perosak tanaman sepanjang kitaran tersebut untuk mengawal perosak seperti serangga, rumpai, kulat dan tikus. Kesan kesihatan terhadap pesawah dilihat seperti fenomena 'aisberg', di mana kesan kesihatan tersebut lebih banyak tidak dapat dikenalpasti. Oleh itu, adalah perlu untuk mengenalpasti jenis-jenis masalah kesihatan yang mungkin disebabkan oleh penggunaan racun makhluk perosak tanaman tersebut. Kajian ini termasuk pemantauan kesihatan kulit, penamtauan paras enzim kolinesterase, ujian fungsi hati, ujian neurokognitif dan ujian genotoxicity. Hasil kajian ini akan digunakan sebagai maklumat rujukan dalam melindungi kesihatan pesawah padi melalui pelaksanaan system pekerjaan yang praktikal.

Berapakah bilangan responden yang akan terlibat dalam kajian ini?
Seramai 100 orang pesawah akan diambil menjadi responden berdasarkan kretaria seperti umur antara 18 hingga 65 tahun, tidak mengambil dadah dan alcohol, dan telah bekerja sebagai pesawah padi lebih daripada satu tahun dan ke atas.

Apakah potensi risiko dalam kajian ini?
Kajian ini mungkin melibatkan peserta dalam beberapa risiko fizikal dan psikologi yang telah dikawal oleh penyelidik sebelum mengumpul data:

a. Responden akan diminta untuk memasuki sebuah bilik gelap untuk mendapatkan bacaan skor kulitpendafluor selepas pendedahan racun perosak. Sesiapa yang mempunyai clithrophobia tidak digalakkan menyertai kajian ini.
b. Sebanyak 5 ml darah melalui venapuncture akan diambil oleh seorang jururawat yang berdaftar dengan Kementerian Kesihatan Malaysia.
c. Sebanyak 0.5 ml darah akan diambil pada jari responden oleh penyelidik.

Apakah manfaat yang akan didapati melalui kajian ini?
a) Sebagai responden kajian:

Hasil kajian berguna kepada pesawah kerana keputusan kajian ini akan digunakan untuk mengenalpasti masalah kesihatan yang di sebabkan pendedahan terhadap racun makhluk perosak tanaman. Pengawasan kesihatan di peringkat awal sangat membantu dalam mencegah kesan penyakit kronik dan mengurangkan komplikasi kesihatan yang mungkin berlaku disebabkan pendedahan tersebut. Pengendalian racun perosak tanaman akan dicadangkan pada akhir kajian ini untuk meningkatkan kesedaran pesawah tentang kesihatan dan mengurangkan pendedahan jangka panjang terhadap racun perosak tanaman tersebut.

b) Sebagai penyelidik kajian:

Kajian ini bertujuan untuk menentukan kesan kesihatan yang mungkin disebabkan oleh pendedahan kronik racun perosak tanaman di kalangan pesawah dan pada masa yang sama menggalakkan kesedaran kesihatan di kalangan kumpulan petani. Maklumat kajian ini mungkin akan digunakan sebagai garis panduan dalam menggubal polisi kesihatan dan program pembangunan dalam penjagaan kesihatan di kalangan petani untuk jangkan masa panjang.

Adakah maklumat kajian ini akan dirahsiakan?
Data dari setiap individu akan dirahsiakan dan dikategorikan sebagai sulit. Tiada sebarang perbincangan individu akan dilakukan dalam kajian ini. Keputusan kajian hanya akan diberikan kepada responden jika diminta sahaja.

Apakah sebarang bayaran akan dikenakan kepad responden?
Sebarang pembayaran tidak akan dikenakan kepada responden dan semua perbelanjaan akan ditanggung oleh penyelidik.

Apakah hak anda sebagai responden?
Kajian ini dijalankan secara sukarela. Dengan itu, responden mempunyai hak untuk berhenti daripada menyertai kajian ini pada bila-bila masa sahaja jika sepanjang kajian ini reponden berasa tidak selesa atau melanggar hak-hak asasi manusia.

Apakah yang perlu anda lakukan?
Anda hanya perlu menurunkan tanda tangan anda pada surat peserta sebagai bukti anda berminat untuk menyertai kajian ini sebagai responden. Ujian ini hanya akan dimulakan selepas anda menandatangani borang tersebut dan setelah anda memahami kandungan surat serta ujian-ujian yang akan dijalankan. Surat persetujuan tersebut perlulah dipulangkan kepada penyelidik sebelum sesi soal selidik dan ujian dijalankan. Jika anda mempunyai sebarang pertanyaan atau memerlukan penjelasan, anda boleh menghubungi mana-mana penyelidik yang disenaraikan di bawah.

Terima kasih atas kerjasama yang anda berikan.

Senarai Nama Penyelidik:

Nama: Hafida Binti Baharum
Email: haffybaharum@yahoo.com
No. Tel: 017-3888451

APPENDIX 2

Consent Letter

FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

BORANG PERSETUJUAN RESPONDEN

TAJUK KAJIAN: PERKAITAN ANTARA ARAS ENZIM HATI DENGAN PENDEDAHAN KEPADA HERBISID

PENYELIDIK : HAFIDA BAHARUM

Saya .... No.K/P: ....
dengan ini secara sukarela bersetuju untuk mengambil bahagian dalam penyelidikan yang dinyatakan di atas. Saya telah dimaklumkan mengenai latar belakang penyelidikan ini dari segi kaedah, kemungkinan kesan buruk dan komplikasi (**rujuk kepada penerangan kepada peserta**). Saya faham bahawa saya mempunyai hak untuk menarik diri dari kajian ini pada bila-bila masa tanpa memberikan apa jua sebab. Saya juga faham bahawa kajian ini adalah sulit dan semua maklumat yang diberikan mengenai identiti saya adalah sulit dan persendirian.

Saya *ingin mengetahui/tidak ingin mengetahui keputusan soal selidik yang dijalankan ke atas saya.

* potong mana yang tidak berkaitan

Tandatangan ....
(*Responden*)

Tarikh :..

Saya mengesahkan bahawa saya telah menjelaskan kepada responden latar belakang dan tujuan penyelidikan di atas.

Tarikh .... Tandatangan..
(Penyelidik)

APPENDIX 3

Questionnaire

No Siri: | | | |

JABATAN KESIHATAN KOMUNITI
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA

PENDEDAHAN RACUN RUMPAI DAN KESAN KEATAS EPARAS ENZIM HATI DIKALANGAN PESAWAH PADI DI TANJUNG KARANG, SELANGOR

Adalah dimaklumkan bahawa satu kajian tentang kesihatan akibat pendedahan kepada racun serangga sedang dijalankan di tempat kerja anda. Sehubungan dengan itu, sukacita dimaklumkan bahawa anda telah terpilih untuk menjadi salah seorang responden kajian ini. Oleh demikian, anda diminta menjawab semua soalan yang dikemukakan dengan mengikut arahan yang telah diberikan. Segala maklumat berkenaan responden akan dirahsiakan dan hanya akan digunakan untuk kajian ini.

ID Responden: | | | | | | | | | | |

Tarikh kajian: ....

No Kad Pengenalan: | | | | | | | | | | | | |

No Telefon: (R) | | | | - | | | | | | | |

(Hp) | | | | - | | | | | | | |

PERKAITAN ANTARA PENGGUNAAN RACUN MAKHLUK PEROSAK TANAMAN DENGAN KESAN KESIHATAN DI KALANGAN PESAWAH PADI DI TANJUNG KARANG, MALAYSIA
KEGUNAAN PENYELIDIK

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

BAHAGIAN B: GAYA HIDUP

7. Adakah anda merokok?

☐ Ya ☐ Tidak

8. Berapa batang rokok anda hisap dalam sehari?

……………………batang

9. Adakah anda mengambil minuman keras / arak?

☐ Ya ☐ Tidak

10. Berapa banyak botol anda minum dalam sehari?

……………………..botol.

BAHAGIAN C: LATAR BELAKANG PEKERJAAN

11. Jawatan pekerjaan sekarang: ....

12. Bilangan tahun anda bekerja di tempat sekarang: .... tahun

13. Jumlah hari bekerja dalam seminggu: .... hari seminggu

14 Jumlah masa bekerja dalam sehari: .... jam sehari

BAHAGIAN D: MAKLUMAT PENGGUNAAN RACUN SERANGGA DI TEMPAT KERJA

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

- ☐ Racun Serangga
- ☐ Racun Kulat
- ☐ Racun Siput
- ☐ Racun Cacing
- ☐ Racun Rumpai
- ☐ Racun Tikus
- ☐ Racun Anai-anai
- ☐ Lain-lain (nyatakan)............................

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

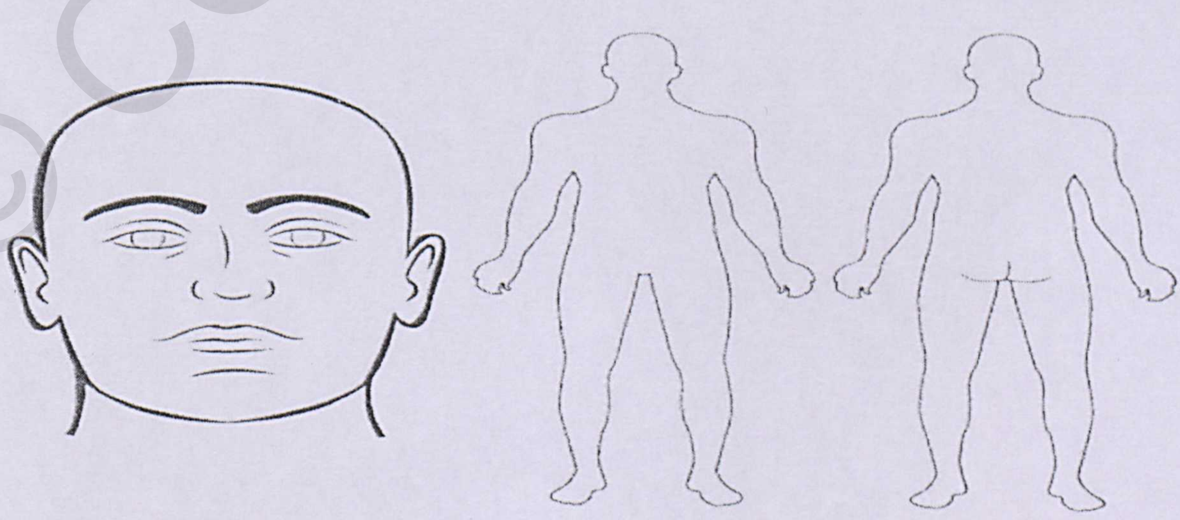
- ☐ Membancuh
- ☐ Mengisi
- ☐ Menyembur
- ☐ Lain- lain (nyatakan)........................

BAHAGIAN E: MAKLUMAT KESIHATAN KULIT

17. Adakah anda mempunyai masalah kulit?

☐ Ya ☐ Tidak

18. Bahagian tubuh yang kebiasaannya mempunyai masalah kulit:
(TandakanX dimana-mana bahagian)



BAHAGIAN F : MAKLUMAT KESIHATAN HATI

18. Adakah anda pernah mengalami gejala kesihatan seperti di bawah? Tanda yang berkenaan sahaja.

Gejala Kesihatan	Sebelum bekerja	Semasa bekerja	Selepas bekerja
Mata berair			
Peluh berlebihan			
Pening kepala			
Cepat letih			
Loya tekak			

APPENDIX 4

Approval Letter from Ethics Committee, FPSK UPM

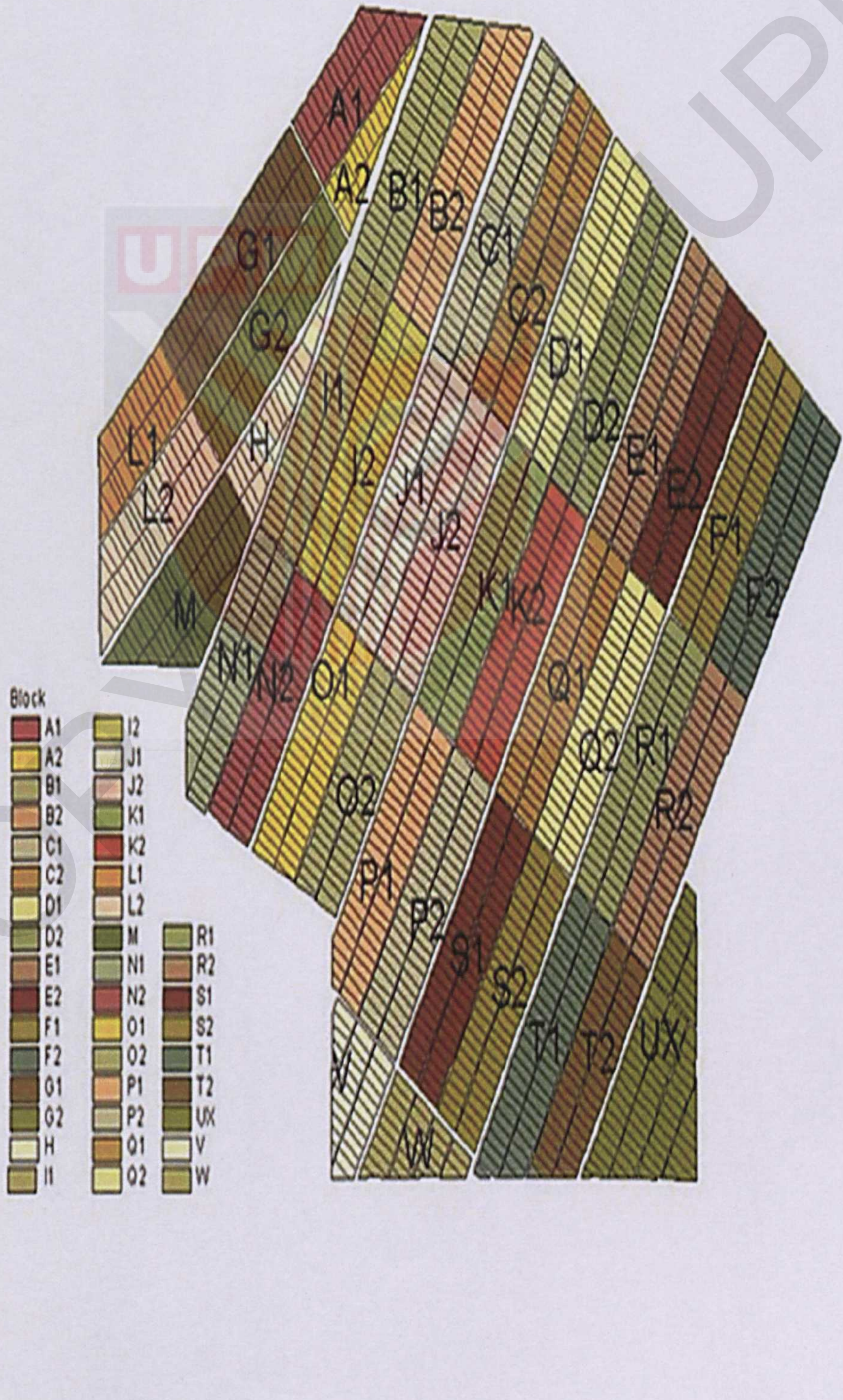
APPENDIX 5

Study Location

Gantt chart

Schedule of Plotting

BLOCK IN SAWAH SEMPADAN



Time Planning (Gantt chart)

Month	January																			
Tasks/date	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
Arriving	0900																			
Set up Dewan, distribute subject information sheet to site supervisor	0900-1200																			
Site visit		0800																		
Observation field work		0800-1200																		
Adding fluorescent dye into pesticide tank			0500-0530																	
Data collection: i. Questionnaire interview (20 minutes) ii. Skin observation (30 minutes) iii. Neurocognitive test (30 minutes) iv. Blood Sample Collection (10 minutes)			1700-1900																	

JADUAL KERJA TANAMAN PADI
(SISTEM TABUR)

BIL	BIL. HARI	AKTIVITI	CATATAN
1	5 hari lepas tuai	Potong jerami (tunggul padi)	Ratakan dan bakar
2	30 hari sebelum tanam, kerja-kerja penyediaan dan rawatan tanah	Bajak 1 keringkan tanah/ cuci parit batas/ merata tanah/ tabor kapur GML dan bajak 2	Tractor/ ketam/ padat tanah kapor GML 3 mt/hk
3	7-10 hari sebelum tanam	Meracun rumpai dan anak padi	Guna Paraquat/ Glyphosate
4	4-5 hari sebelum tanam	Masukkan air ke petak sawah	Tenggelamkan tanah
5	2-3 hari sebelum tanam	Bajak 3 dalam air/ kawalan tikus	Tenggelamkan tanah/ kawalan tikus ulang 2 minggu
6	2 hari sebelum tanam	Rendam benih 8 beg x 20kg/ Lot	Campur Zapa/ penggalak cambah
7	1 hari sebelum tanam	Buang air sebelah petang/ bajak 4 pagi keesokannya	Bajak Niplo/Badai (untuk kawalan padi angin)
8	0 hari tanam/tabur	Tabur benih 160Kg/HK Alirkan air bertakung	Tabur benih sekata 6 jalan/Lot. Taburan terlalu kuat/jauh mengakibatkan benih padi terganggu percambahannya.
9	1 hari selepas tanam	Masukkan air hingga tenggelam rata. Jangan terlalu dalam/tidak nampak tanah.	Biarkan 10-15 hari anak padi tumbuh di permukaan air/ tukar air jika berlumut merah.
10	10-15 hari selepas tanam	Kawalan rumpai saka/sambau/color cina dll. Kawalan rumpai air/rusiga/kerak-kerak telinga tikus dll.	Facet/Basmin/Nominee/ Solito/NU NPCA CLINCHER (pilih yang sesuai dan guna kadar yang disyorkan.)

11	15-20 hari selepas tanam	Membaja campuran/UREA dan membuat lorong kerja	8 beg campuran/6 beg UREA
12	25-30 hari selepas tanam	Kawalan serangga/ulat lipat daun. Kawalan bena perang Kawalan rumpai daun lebar jika perlu. Membaja organik subsidi. Meracun batas/ menyulam/baja semburan.	Norylee/Match/Applaud/ Comfidor Robas/Baja semburan Tabur baja organik subsidi 6 beg.
13	30-35 hari selepas tanam	Membaja campuran/ Urea. Kawalan penyakit/ karah/bintik perang/dan hawar seludang. Baja semburan/Robas.	6 beg Urea/8 beg campuran. 0 Pus/Bavistin/Amure/ Fujione/Polycure Robas/ketahanan pokok/baja semburan.
14	40-45 hari selepas tanam	Tabur baja Urea/campuran. Kawalan penyakit karah/bena perang/hawar. Kawalan serangga bena perang/ulat daun Semburan Robas/baja semburan.	Urea 6 beg/Campuran 7 beg. 0-Pus/Bavistin/Amure/ Policure/Amstar Applaud/Comfidor/Actara Robas/ketahanan pokok/baja semburan.
15	55-65 hari selepas tanam	Kawalan penyakit/serangga dan baja tambahan jika perlu.	Serangga/penyakit. Rujuk di atas. Baja 15-15-15 / 12-12-17

16	65-75 hari selepas tanam	Menakai/membuang padi angin . Baja semburan Robas.	Kurangkan air di sawah
17	70-80 hari selepas tanam	Kawalan serangga penyakit. Baja tambahan jika perlu.	Match/Norylee/ Penyakit Polycure+O-Pus/Amstar. Baja tambahan jika perlu.
18	90-100 hari selepas tanam	Buang air secara beransur.	Alirkan air bertakung. Pastikan penuaian padi sawah tidak berair.
19	110-115 hari selepas tanam	Menuai padi. Penuaian terlalu awal mengakibatkan kehilangan hasil lebih kurang. 5biji x 3,000.000 tangkai/lot = = $\frac{15,000.000 \times 28gm}{1,000}$ = 420,000gm (420kg)	Pastikan jentuai/padi tidak cicir dan bersih.

Disediakan Oleh: Pengurusan PEP S/SEMPADAN

* KAEDAH INI TERTAKLUK KEPADA KEADAAN SEMASA DAN ALAM SEKITAR.