

# Chapter 5

## Recommendations

The results of the research study raises critical issues regarding the safety and health of women sprayers on plantations that need further scrutiny and exploration.

The current study is an attempt to throw some light into the pathetic conditions of women workers in plantations and is a step closer in identifying the need for future research, training and policy level interventions.

The reduction or prevention of toxicity related to pesticide usage in the country would entail:

- support and implementation of a systematic pesticide use reduction policy with the aim of replacing them with long-term, safe and ecological solutions to pest management.
- Banning the use of WHO Class 1 pesticides in Malaysia
- Banning Paraquat
- A systematic review, evaluation and screening of all pesticides both for their acute and chronic toxicity in the conditions of use in Malaysia. These pesticides need to be screened for their reproductive and endocrine-disruptive effects with bans and severe restrictions being imposed on these chemicals. Since in reality it is impossible to catch up with all the screening that has to be undertaken, the precautionary principle needs to be adopted, when dealing with pesticides where toxicological hazards have been established and risks not fully understood, or where there are toxicological gaps in knowledge either on the precise effects of the pesticides or on the mechanisms for toxicity.

At the same time, it is necessary to ensure that there is in place legislation to control the use of pesticides and an infrastructure to enforce the violation of legislation. Sound pest management techniques must be practised to control pests and avoid their becoming resistant. Training and information activities concerning pesticide safety must be established for educating pesticide distributors and users in addition to sprayers. Simultaneously, there is need for continued research to seek safe and ecological solutions for agriculture and public health use.

Recommendations for future action and intervention include:

### - **Information Sharing and Dissemination**

Need for information that are clear and easy to understand on pesticide usage and precautions to be followed. Pesticide companies should be responsible for placing instructions and signs of caution on containers. The manufacturers' Material Safety Data Sheet (MSDS) is a good source of information for estate management and employers.

Estate management to provide complete information to sprayers on the types of pesticides used, and possible health hazards thereof. Trade union leaders to be made aware of the potential hazards from pesticides, so that the issue is tackled at trade union discussions and negotiations with estate management.

### - **Education**

Plantation workers need to be educated on the precautionary measures to be followed while handling pesticides; common symptoms of pesticide poisoning; their legal rights as workers and the legal framework supporting their cause. The National Union of Plantation Workers (NUPW) should set up a Health and Safety Committee that provides information, conducts training and capacity building for its members. A standard training protocol for plantation workers should include the following:

- a) Understanding of health hazards
- b) Adoption of proper work practises
- c) Use of protective equipment
- d) Practice of good personal hygiene
- e) Recognition of early symptoms
- f) Quick first aid
- g) Safe transport and storage of pesticides, safety labels and datasheets
- h) Proper disposal of empty containers

With education and awareness, workers will be empowered to resist injustice and violation of rights in plantations.

- **Medical care**

Establishment of a fully equipped clinic available on the plantation capable of identifying and treating pesticide related emergencies such as burns, skin problems, breathing disorders, nausea and vomiting etc. The clinic staff should preferably be a woman, so that sprayers can discuss health problems comfortably.

In addition, it is essential that medical professionals in plantation clinics, government and private hospitals be trained to identify and treat symptoms and clinical data for pesticide toxicity. A training protocol for medical care specifically related to pesticides should be developed and included as part of the curriculum in medical schools.

Furthermore, it is suggested that hospitals document and routinely monitor cases of pesticide related poisoning and also conduct detailed research with clinical data on the effects of pesticide toxicity.

- **Compliance**

There is an urgent need to monitor and ensure that pesticide companies adhere to the established regulations regarding distribution of banned pesticides. Plantation workers can play a key role in the monitoring and collection of information on pesticides used on the plantations

- **Legislation**

There is need to review existing regulations governing occupational safety and hazards, and their compliance in the country – especially with regard to the formation of Safety and Health Committee, and planning a research agenda on the pesticides issue. Ban WHO Class I pesticides and Paraquat and stop the use of pesticides known or suspected to be carcinogenic (cancer causing effects), endocrine-disrupters (causing reproductive and fertility problems) and immune-system suppressants.

- **Strengthening OSHA**

There should be a formation of the Safety and Health Committee to monitor the health effects experienced by plantation workers, especially the sprayers. Addressing the weaknesses in OSHA as identified earlier in the report.

Training of Social Security Review Board on the effects and hazards of chemicals on people's health in order to ensure proper compensation to workers affected by chemicals.

- **Promotion of Alternatives**

Farmers, agricultural workers and horticulturists should be encouraged to experiment with and practise non-chemical methods of pest control and develop a conscious strategy to reduce the use of pesticides in plantations.

- **Advocacy**

Widespread dissemination of information on pesticide related hazards in print and other media, and an urgent need for policy intervention and regulation of pesticide use in Malaysia.

- **Integration of Gender Perspective**

To integrate the gender perspective in occupational safety and health legislation, it is imperative to take into account the three roles of women - housewife, mother and worker, and the need for special protection of women in hazardous conditions. There should be equal employment opportunities for both women and men. This requires that due regard is paid to family needs, while working to enable all to develop their potential, child care services, flexible working time arrangements, non penalising career breaks and leave sanctions. Access to training also needs special attention.

Targetting the enterprises (plantations), preventive programmes should be planned to control the occupational hazards, deal with psycho-social and organisational factors, and revise work practices to reduce hazards and job designs of women workers.

At the individual level, workers should participate in protective programmes, ensure that they have the option of work modification, reassignment and rehabilitation, if necessary, especially during pregnancy and child bearing times. Ergonomic considerations regarding the manual handling and load carrying should be ensured to meet standards.

There is also a need to plan for human variability, avoiding generalisations about women's physical capacities and vulnerabilities, and taking into account individual capability of workers based on age and sex. Research to examine existing information or bias and avoid erroneous judgement on the issue is essential. National occupational health and safety statistics, with specific focus on women need to be substantiated. Women need to be better represented in decision making bodies concerning occupational health and safety, with adequate access to training, information and freedom to organise themselves into formal and informal groupings.

- **Future needs for research**

In terms of research needs to substantiate the harmful effects of specific pesticides to health symptoms, more studies are required to identify the effects of pesticides other than organophosphates. In light of emerging discussions on Endocrine Disruptors, there is an urgent need to collect data on the health impacts of pesticides on children, such as hyperactivity, poor performance in schools, aggression, asthma and respiratory problems to name a few. It may also be useful to document and compare the health status of children of sprayers and non-sprayers in plantations.

Without concrete quantitative information on the pesticides used, it is difficult to ascertain the level of toxicity amongst workers. Future studies should address this information gap on the specific types and quantities of pesticides used on plantations. As an important part of obtaining information, there is the prerequisite that both government agencies and the industry's right to know and freedom of information. It is only through an environment that promotes transparency and sharing of information, that we can effectively address strategies for intervention to protect health and lives of women sprayers and the estate community.

Research is also required on documenting the long term effects of pesticide exposure, especially on women who have been spraying pesticides for many years.

In the product developmental stage, research is required to develop lesser toxic molecules and adopt safer formulations, provide safer techniques of application and ensure complete toxicological testing of a product before it is marketed, to develop suitable methods for exposure measurements on users and on the environment. More specifically, evaluation of potential risks to workers must be evaluated in terms of regulation and post-registration surveillance.

Post-product development and marketing, pesticide manufacturing companies in collaboration with plantations should promote the safe use of pesticides, workers' participation in the management of health risk at the workplace (plantations), hazard identification, assessment of exposure and health surveillance. These include pre-employment medical examination, periodic assessment of health status of workers and biological monitoring.

In general, all users should be educated to avoid the use of unnecessary pesticides, adoption of safe practices and pesticide application and crop defense.

In the area of empowerment of women workers, more studies are needed to document the factors undermining the reproductive rights and sexuality of women in plantations. Further education and awareness campaigns should target these issues.

pdfMachine by BroadGun Software

## References

- AGROW, August 1996. *Malaysian Agrochemical Sales + 5 % in 1995*. No. 261 p 17.
- AGROW, October 1998. *More Agchems on Malay Palms*. No. 313 p 21.
- AGROW Crop Protection News, April 16, 1999, and September 17, 1999.
- Alavanja M.C.R., Sandler A.P., McMaster S.B., Zahm S.H., McDonnell C.J., Lynch C.F., Pennybacker M., Rothman N., Dosemeci M., Bond A.E. and Blair A., 1996. *The Agricultural Health Study. Environmental Health Perspectives*, Vol.104, No.4 p 362-369.
- AN/CTA 1995. *Pesticides in Tropical Agriculture. Hazards and Alternatives*. p 186 – 188.
- Arumugam V., 1992, *Victims without Voice. A Study on Women Pesticide Workers in Malaysia*. Tanaganita and PAN AP.
- Awang R., Samah N.A., Razak D.S., Latiff A.A., Bahari M.B., Majid M.I.A., Ariffin R. and Ibrahim P., 1991. *Monitoring of Poisoning Cases Involving Natural Toxins in a Teaching Hospital in Kelantan*. Paper presented at the 10<sup>th</sup> World Congress on Animal Plant and Microbial Toxins. 3-8 November 1991.
- Bull D., 1982. *A Growing Problem – Pesticides and the Third World Poor*. Oxfam.
- Chester G. and Woollen B.H., 1981. *Studies on the Occupational Exposure of Malaysian Plantation Workers to Paraquat*. British Journal of Industrial Medicine, 38, p 23-33.
- Chinvarakorn V., 1999. *Sold on Hi-tech Farming*. The Bangkok Post, June 1999.
- Cole D.C., McConnell R., Murray D.L. and Anton F.P., 1988. *Pesticide Illness Surveillance: The Nicaraguan Experience*. PAHO Bulletin 22(2) p 119-132.
- Consumers Association of Penang (CAP), 1996. *Pesticide Contamination Continues*. Utusan Konsumer, mid July 1996, p 5.
- Copplestone J.F., 1985. *Pesticide Exposure and Health in Developing Countries*. In: (Turnbull G.J. ed.) Occupational Hazards of Pesticide Use. London, Taylor and Francis.
- Delilkan A.E., Namazie M. and Ong G., 1984. *Organophosphate Poisoning: A Malaysian Intensive Care Experience of One Hundred Cases*. Med. J. Malaysia. Vol. 39 No. 3 p 229-233.
- Dinham B., 1993. *The Pesticide Hazard. A Global Health and Environment Audit*. Compiled The Pesticides Trust, p 173-181.
- ETC Group (Action Group on Erosion, Technology and Concentration), "Globalization Inc. — Concentration in Corporate Power: The Unmentioned Agenda" July/August, 2001, available at <http://www.rafi.org>.
- Gerwien I. and Bauer C., 1989. *Pesticide Regulation in Malaysia. A Comparison to the German Law in Consideration of the Relevant Regulations of the European Community and the FAO. (A special report)* p 43, FRG, University of Bremen.
- He F. and Chen S., 1998. *Health Impact of Pesticide Exposure and Approaches to Prevention*. Asian-Pacific Newsletter 6 (3).
- Howard J.K., Sabapathy S.S. and Whitehead P.A., 1981. *A Study on Health of Malaysian Plantation Workers with Particular Reference to Paraquat Sprayers*. British Journal of Industrial Medicine, 38: p 110-116

Howard V., 1997. *Synergistic Effects of Chemical Mixtures – Can We Rely on Traditional Toxicology?* The Ecologist. Vol. 27, No. 5, September-October 1997.

<http://agrolink.moa.my/dpn>

ILO, 2000. *Safe Use of Pesticides*. Occupational Safety and Health Series 38.

ILO website. <http://www.ilo.org>

Jeyaretnam J., 1982. *Health Hazard Awareness of Pesticide Applicators about Pesticides*. In: (Van Heemstra, E.A.H.; Tordoir, W.F.; ed.) *Education and Safe Handling of Pesticide Application*. Elsevier, Amsterdam, Netherlands, p 23-30.

Jeyaretnam J., 1985. *Health Problems of Pesticide Usage in the Third World*. British Journal of Industrial Medicine, 42, p 505-506.

Jeyaretnam J., Lun K.C. and Phoon W.O. 1987. *Survey of Acute Pesticide Poisoning among Agricultural Workers in Four Asian Countries*. Bulletin of the World Health Organisation, 65: p 521-527.

Jeyaretnam J., 1990. *Acute Pesticide Poisoning: A Major Global Health Problem*. World Health Statistics Quarterly, 43.

Kishi M., Hirschhorn N., Djajadisastra M., Satterlee L.N., Strowman S. and Diits R., 1995. *Relationship of Pesticide Spraying to Signs and Symptoms in Indonesian Farmers*. Scand J Work Environ Health, 21 p 124-133.

Kricker A., McCredie J., Elliott J. and Forrest J., 1986. *Women and the Environment: A Study of Congenital Limb Anomalies*. In: Community Health Studies Vol. X Number 1 p 1-11.

Laws of Malaysia, Act 149 (1980). *Pesticides Act 1974*, p 64.

Lee S.A. and Chung G.F., 1985. *Safety Aspects of LV, Vi.V, ULV and CDA Application*. In: (Teoh C.H., ed.) *Recent Developments in Pesticide Application Technology: Proceedings of the Workshop, 21 January 1985*. Malaysian Plant Protection Society, Kuala Lumpur, Malaysia. p 46-66.

Lum K.Y., Mamat Jusoh Md., Cheah U.B., Castaneda C.P., Rola A.C. and Sinhaseni P., 1990. *Pesticide Research for Public Health and Safety in Malaysia, the Philippines and Thailand*. In: *Impact of Pesticide Use on Health in Developing Countries*. Proceedings of an IDRC Symposium held in Ottawa, Canada.

Malaysian Agricultural Digest and Index 1999/2000. 8<sup>th</sup> ed. p 177-186, Kuala Lumpur, Agriquest.

Mitton R., March 7, 1997. *"It's a Form of Slavery" The Suffering Classes-Plantation Workers*, Asiaweek.

Moses M., 1996. *Designer Poisons. How to Protect your Health and Home from Toxic Pesticides*. Pesticide Education Centre USA.

Moses M., 1999. *Pesticides and the Health of Women and Children*. Paper presented at the Women and Pesticides Workshop, Penang, 1999.

Moses M., 1999. *"Pesticides – Killers in our Midst"*, Safe Food Campaign 1999. Warning: Pesticides are Dangerous to Your Health! Stop Endocrine Disrupting Chemicals!. p 8-15, PAN AP.

New Straits Times (A), May 8 1991. *"Law: Need to Review the Use of Chemical Pesticides"*, a two-day seminar on Pest Management and the Environment in the Year 2000.

New Straits Times (B), May 9 1991.

Occupational Safety and Health Act (OSHA), 1994. (Act 514) *Regulations and Orders*. International Law Book Services.

- Ong K.W., 1996. *Changing Acres: Sustainable Agriculture Country Profiles*. Malaysia, PAN AP.
- PAN AP, 1999. *Warning! Pesticides are Dangerous to your Health*, Community Pesticide Action Kits (CPAK).
- Pesticides Board, 1996. *Pesticides Act 1974, Guidelines on Pesticide Advertisements*, Kuala Lumpur, p 10.
- Pesticides News, March 2000. *Research Shows Dangers of Chemical Mixes*. No. 47 p 10. PAN UK.
- Rajendra E., 1996. *Coming Face to Face with the Dangers of Pesticides*, May 5 1996, SUN.
- Ramasamy S. and Nursiah M.T.A., 1988. *A Survey of Pesticide Use and Associated Incidences of Poisoning in Peninsular Malaysia*. J Pl. Prot. Tropics, 5(1): p 1-9.
- Razak D.A., Latiff A.A., Majid M.I.A. and Awang R. *Case Study: Malaysian Information Service on Pesticide Toxicity in Encyclopedia of Occupational Health and Safety 22.1*.
- Rengam S., 1991. *Poisoned Harvest: Pesticide Problems in Asia*. Paper presented at the Women and Pesticides Training Workshop, Kuala Lumpur, 3-8 June 1991.
- Rengam S., 1994. *Citizens Action for Pesticide Reform*. PAN AP, Penang, p 25-26.
- Sinnaia S., 1989. *Problem of Poisoning in Malaysia*. Paper presented at the First Malaysian-Asian International Meeting on Prevention and Management of Poisoning by Toxic Substances, 27-28 November 1989, Kuala Lumpur, Malaysia. Mimeo, p 15.
- Sim F.G., IOCU, 1985. *The Pesticide Poisoning Report. A Survey of some Asian Countries*. p13-19.
- Smolen M., 1999. "Endocrine Disruption: New Threats from Old Chemicals", Safe Food Campaign 1999. Warning: Pesticides are Dangerous to Your Health! Stop Endocrine Disrupting Chemicals!. p 26-36, PAN AP.
- Swan A.A.B., 1969. *Exposure of Spray Operators to Paraquat*. British Journal of Industrial Medicine, 26, p 322-329.
- Tan S.H., Ramasamy S., Yeoh C.H. and Ahmad K., 1988. *A Comparative Study on the Occupational Exposure of Spray Workers using Knapsack and Spinning Disc Sprayers*. In: (Teng P.S., Heong K.L., ed.) *Pesticide Management and Integrated Pest Management in Southeast Asia: Proceedings of the Southeast Asia Management and Integrated Pest Management Workshop, 23-27 February 1987, Pattaya, Thailand*. Island Publishing House, Manila, Philippines, p 407-415.
- The Pesticides Trust, 1993. Broadsheet "The Control of Pests and Pesticides."
- US EPA, 1999. *Recognition and Management of Pesticide Poisonings*, 5<sup>th</sup> edition.
- Vinesh D., October 9, 1999. "Sprayers Ignorant of Dangers", The Star.
- Women in Action, 4/1989. *Malaysian Women Plantation Workers*.
- Whitaker M J., 1989. *The Handling and Use of Paraquat by Malaysian Rubber and Oil Palm Smallholders*. Journal of Plant Protection in the Tropics 6(3): p 231-249.
- WHO website. <http://www.who.int>
- WHO/UNEP, 1990. *Public Health Impact of Pesticides Used in Agriculture*, p 34-36.
- Yusof K., Zulkifli S.N., Aye K.W., Khin Maw U., Perumal R. and Abu Bakar M.A., 1995. *Environmental Health in Ranau, Sabah: The Impact of Farming and Mining Activities*. IRPA R&D project no. 03-07-04-120.
- Zain, 1998. Siti Mariam M.A. Zain, *Racun Rosakan Bumi*, MASSA 24 January.

## Appendix 1

### The Survey Questionnaire

WOMEN CONFRONTING THE CYCLE OF POISON

Questionnaire On Pesticide Spraying In Plantations

Name: .....

Location: .....

Personal Particulars:

Sex: .....

Age: .....

Race: .....

Marital Status: .....

Occupation of Spouse: .....

No. of children: .....

Nature of work/Occupation: .....

Length of Service: .....

Salary: .....

Are you a: Permanent worker  contract worker  migrant

Working hours (no of hours of work): per day  per week  per month

Are you pregnant or breastfeeding. ....

Pesticide Use

Are you a pesticide sprayer  Yes  No

1. What class of pesticide used in the field:

Weedicide  Insecticide  Fungicides  Others

2. What pesticide do you use?

Common Name: \_\_\_\_\_ Name: \_\_\_\_\_

What is it used for? \_\_\_\_\_

How often in a year do you apply this? \_\_\_\_\_

Do you spray throughout the year? Yes \_\_\_\_\_ No

Is there a break given? Yes \_\_\_\_\_ No

If there is a break, for how long? \_\_\_\_\_

What type of task are you assigned? \_\_\_\_\_

How long after spraying are you assigned to another task? \_\_\_\_\_

Frequency in a month \_\_\_\_\_

Number of hours per spray \_\_\_\_\_

3. Equipment:

Method of spray (equipment used) \_\_\_\_\_

What was the condition of the equipment? \_\_\_\_\_

How is it stored? \_\_\_\_\_

Was training provided on use? \_\_\_\_\_

4. Protective clothing:

Was protective clothing/equipment supplied? Yes  No

If yes, what were they? coveralls  gloves  eye and face protective   
aprons and coats  protective boots  respiratory equipment

Is protective clothing washed after it is used? Yes  No

5. Mixing of Pesticides

Do you mix the pesticides before spraying? Yes  No

If not, who mixes? \_\_\_\_\_

What is the pesticide mixed with? \_\_\_\_\_

What are the quantities? \_\_\_\_\_

Do you mix it with other pesticides? Yes  No

If yes what are they? \_\_\_\_\_

What are the quantities? \_\_\_\_\_

6. Effects of the Pesticide

After spraying do you suffer from:-

- Nausea
- Giddiness
- Headache
- Vomiting
- Difficulty in breathing
- Tight feeling of chest
- Itchiness / skin irritation / white patches on skin / red spots  
(Where on the body?)
- Bleeding through the nose
- Blurred vision
- Tremors
- Lower abdominal pains

- Vaginal pains
- Burning sensation during urination
- Fatigue / tiredness
- Back pains
- Swelling of the knee joint
- Discolouration of nails / inflammation and irregular nails / nails dropping off
- Others

7. Have you been exposed to pesticides / come in contact with pesticides

- |                          |                              |                             |
|--------------------------|------------------------------|-----------------------------|
| Through Inhalation       | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| On the skin              | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Accidentally consumed it | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

MEDICAL

1. Who do you go to when you have any of the effects of poisoning?  
 \_\_\_\_\_  
 \_\_\_\_\_
2. What treatment is given?  
 Medicines: type: cream  drug / tablets for consumption  liquid form
3. Do you go for regular medical check-up?  
 \_\_\_\_\_  
 \_\_\_\_\_
4. Where do you go for the check-up?  
 \_\_\_\_\_  
 \_\_\_\_\_
5. Who conducts the medical examination?  
 \_\_\_\_\_  
 \_\_\_\_\_
6. Is there a policy in the plantation on sending sprayers for regular check-up?

## Phase I: Sample Selection and Distribution within Estates

Estate No.	Place	State	No. of Subjects (n)
1.	Serdang	Kedah	8
2.	Serdang	Kedah	3
3.	Bukit Lembu	Kedah	3
4.	Batu Lintang	Kedah	4
5.	Bukit Selambau	Kedah	3
6.	Kulim	Kedah	2
7.	Kuala Ketil	Kedah	3
8.	Sungai Petani	Kedah	3
9.	Kulim	Kedah	4
10.	Kulim	Kedah	5
11.	Kulim	Kedah	6
12.	Mahang	Kedah	1
13.	Mahang	Kedah	1
14.	Trong, Taiping	Perak	15
15.	Nibong Tebal	Penang	3
16.	Taiping	Perak	3
17.	Nibong Tebal	Penang	5
<b>TOTAL:</b>			<b>N = 72</b>

## Phase II:

## Estates involved in the Self-Health Monitoring Cards Programme











Estate No.	Place	State	No. of subjects (n)
1	Sungai Petani	Kedah	17
2	Sungai Siput	Perak	2
3	Sungai Siput	Perak	15
4	Trong	Perak	22
5	Teluk Intan	Perak	11
<b>TOTAL:</b>			<b>N = 67</b>






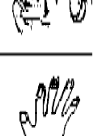





### Appendix 3

## சுகாதார குறிப்பு / REKOD KESIHATAN

பெயர் :  
 Nama: \_\_\_\_\_  
 வயது :  
 Umur: \_\_\_\_\_

அடையாளக் காட்டு எண்:  
 No Kad Pengenalan: \_\_\_\_\_  
 தோட்டம்:  
 Tempat: \_\_\_\_\_

எண் No	நோய் அறிகுறிகள் Tanda - Tanda Penyakit	திகதி / Tarikh					
1	 குமட்டல் Rasa Mual						
2	 வாந்தி Muntah						
3	 மயக்கம் Pening Kepala						
4	 தலைவலி Sakit Kepala						
5	 மூக்கில் ரத்தம் Hidung Berdarah						
6	 மூச்சுத் திணறல் Susah Bernafas						
7	 நெஞ்சு இறுக்கம் Dada Ketat						
8	 முதுகு வலி Sakit Belakang						
9	 நடுக்கம் Menggigil						
10	 முட்டிக்கால் வீக்கம் Bengkak Lutut						

எண் No	நோய் அறிகுறிகள் Tanda - Tanda Penyakit	திகதி / Tarikh					
11	 சோர்வு / களைப்பு Penat						
12	 அடிவயிற்று வலி Kesakitan Bawah Perut						
13	 பெண் குறியில் வலி Sakit Faraj						
14	 சிறுநீர் கழிக்கையில் எரிச்சல் Pedih semasa kencing						
15	 கண் அரிப்பு Gatal Mata						
16	 யங்கலான பார்வை Kelihatan Kurang Terang						
17	 நகம் நிறமாறுதல் Ubahan Warna Kuku						
18	 விரல்கள் வீங்குதல் Bengkak Jari						
19	 நகம் விழுதல் Kuku Tanggal						
20	 சொறி / அரிப்பு Kudis / Gatal						
21	 உடல் மூட்டு வலி Sakit Sendi Badan						

## Appendix 4

### Ellman Method for Measurement of Serum Cholinesterase Enzyme Activity

The specimens collected were kept cool until transfer to the laboratory, where they were stored at  $-10^{\circ}\text{C}$ . Blood analysis was carried out immediately and the results were communicated to the subject. The chemical reaction involved in the cholinesterase assay is as follows:



Thiocholine + 5,5'



Cholinesterase hydrolyzes butyrylthiocholine (BTC) to yield thiocholine which reacts with 5,5'-dithiobis-2-nitrobenzoic acid (DTNB) to form the yellow 5-thio-2-nitrobenzoate with an absorbance maximum at 405 nm. Therefore, the rate of change absorbance at 405 nm is directly proportional to the cholinesterase activity.

Reagents:

Butyrylthiocholine iodide	5 mmol/L
DTNB	0.25 mmol/L
Buffer	pH $7.2 \pm 0.1$
Non-reactive stabilizers and fillers	

Chemicals and equipment:

1. Cholinesterase (BTC) reagent obtained from Sigma Chemical Company (USA)
2. A spectrophotometer with a temperature controlled cuvette compartment and capable of measuring absorbance at 405 nm
3. Cuvettes
4. Pipetting device

Testing Procedure:

The temperature of the reaction mixture was maintained at  $30^{\circ}\text{C}$ .

1. Cholinesterase (BTC) reagent was prepared according to the instructions stated from the manufacturer.
2. The spectrophotometer wavelength was adjusted to 405 nm and the absorbance reading to zero with water as reference.
3. The reagent was incubated to the assay temperature.
4. To a cuvette labeled TEST, 1.0 mL of the Cholinesterase reagent was added to it. The cuvette was placed into the temperature controlled cuvette compartment.
5. 10  $\mu\text{l}$  of sample was added to the cuvette and the solution was mixed immediately by inversion. The solution was then incubated at  $30^{\circ}\text{C}$  for 15 seconds.
6. The absorbance (A) of TEST was measured at 405 nm versus water as reference. This is identified as INITIAL A.
7. The incubation was continued further for 30 seconds following the initial absorbance reading. The absorbance reading after 30 seconds was identified as FINAL A.
8. The difference in the absorbance during the said period,  $\Delta A$  per 30 seconds was obtained by subtracting INITIAL A from FINAL A.  $\Delta A$  per minute was obtained by doubling the value of the difference in the absorbance during 30 seconds.
9. The cholinesterase activity (U/L) of the sample with the following equation:

$$\text{Cholinesterase activity} = \Delta A \text{ per min} \times 7426$$

WHO Class I Pesticides in Malaysia

No.	Name	Class		
1.	Buto Carboxim	1b	Insecticide/Nematicide	
2.	Cadusafos	1b		
3.	Carbofuran	1b		
4.	Dichlorvos	1b		
5.	Fenamiphos	1a		
6.	Furathiocarb	1b		
7.	Isazofos	1b		
8.	Methamidophos	1b		
9.	Methidathion	1b		
10.	Monochrotophos	1b		
11.	Thiometon	1b		
12.	Triazophos	1b		
13.	Captafol	1a		Fungicide Household/Veterinary/ Public Health
14.	Coumaphos	1a		
15.	Brodifacoum	1a	Rodenticide	
16.	Bromadiolone	1a		
17.	Chlorophacinone	1a		
18.	Coumatetralyl	1b		
19.	Difethialone	1a		
20.	Diphacinone	1a		
21.	Flocoumafen	1a		
22.	Warfarin	1b		