พฤติกรรมการใช้และปัจจัยที่มีอิทธิพลต่อการลดการสัมผัสสารกำจัดศัตรูพืชในกลุ่มเกษตรกรในขอนแก่น ประเทศไทย

Pesticide Use and Factor Affecting Exposure Reduction Pratices Among Farmers in Khon Kaen, Thailand

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บทคัดย่อ

การศึกษาแบบภาคตัดขวางครั้งนี้ มีวัตถุประสงค์ เพื่อศึกษาผลกระทบต่อสุขภาพจากการใช้สารกำจัดศัตรูพืช และปัจจัยที่มีอิทธิพลต่อการลดการสัมผัสสารกำจัดศัตรูพืช ของกลุ่มเกษตรกร จากกลุ่มตัวอย่าง 560 คน โดยการสุ่มอย่างง่ายตามขนาดสัดส่วนประชากร จาก 10 หมู่บ้านในเขตอำเภอเมือง จังหวัดขอนแก่น เก็บรวบรวมข้อมูลโดยใช้แบบสอบถาม วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา และสถิติเชิงอนุมาน ได้แก่ Multiple logistic regression นำเสนอค่า Crude OR, Adjusted OR และ ช่วงเชื่อมั่น 95%CI

ผลการศึกษา พบว่า เกษตรกรเป็นเพศหญิง ร้อยละ 51.6 มีอายุเฉลี่ย 53.2±11.9 ปี เรียนจบชั้นประถมศึกษาร้อยละ 94.5 ปลูกข้าวร้อยละ 91.6 ค่ามัธยฐานระยะเวลาการใช้สารกำจัดศัตรูพืช 20 ปี ต่ำสุด 1 ปี สูงสุด 60 ปี ใช้สารกำจัดศัตรูพืชมากกว่าที่ฉลากแนะนำร้อยละ 38.8 ใช้สารโฟลิดอน (สารกลุ่มออร์แกโนฟอสเฟต) ร้อยละ 58.2 ไม่สวมแว่นตาขณะพ่นสารเคมี ร้อยละ 76.3 มีผลกระทบต่อสุขภาพจากการสัมผัสสารกำจัดศัตรูพืชของเกษตรกร ได้แก่ คอแห้ง, มึนงง, เหนื่อย และเหงื่อออกมาก คิดเป็นร้อยละ 46.6, 30.5, 25.6 และ 25.4 ตามลำดับ ปัจจัยที่มีความสัมพันธ์กับการลดการสัมผัสสารกำจัดศัตรูพืชของเกษตรกรอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 ได้แก่ ระยะเวลาที่ใช้สารกำจัดศัตรูพืชโดย กลุ่มเกษตรกรที่มีประสบการณ์ 20 ปีขึ้นไป มีการปฏิบัติในการลดการสัมผัสสารกำจัดศัตรูพืชเป็น 1.69 เท่าของกลุ่มที่มีประสบการณ์น้อยกว่า 20 ปี (95%CI : 1.12-2.54) และการใช้สารกำจัดศัตรูพืชตามฉลาก ซึ่งพบว่า กลุ่มที่มีการใช้สารกำจัดศัตรูพืช ตามที่ฉลากกำหนด มีการปฏิบัติในการลดการสัมผัสสารกำจัดศัตรูพืชเป็น 2.33 เท่า ของกลุ่มที่มีการใช้สารกำจัดศัตรูพืชมากกว่าที่ฉลากกำหนด (95%CI : 1.53-3.54)

ข้อเสนอแนะ ควรส่งเสริมให้เกษตรกรลดการใช้สารกำจัดศัตรูพืชและมีพฤติกรรมลดการสัมผัสสารกำจัดศัตรูพืชเพิ่มขึ้น โดยการสะท้อนถึงพฤติกรรมที่ไม่เหมาะสม และผลกระทบต่อสุขภาพจากการสัมผัสสารเคมีกำจัดศัตรูพืชที่พบในการศึกษา รวมทั้งสร้างความรู้ทัศนคติและแนวทางการปฏิบัติที่ถูกต้องในการลดการสัมผัสสารกำจัดศัตรูพืช เช่นการใส่อุปกรณ์ป้องกันการสัมผัส การผสมตามสัดส่วน รวมทั้งอบรมการผลิตและส่งเสริมใช้สารอินทรีย์กำจัดศัตรูพืชเพื่อเป็นทางเลือกในการลดการใช้สารเคมีกำจัดศัตรูพืช

คำสำคัญ : การใช้สารกำจัดศัตรูพืช ความเสี่ยงด้านสุขภาพ พฤติกรรมลดการสัมผัสสารกำจัดศัตรูพืช ผลกระทบต่อสุขภาพจากการสัมผัสสารกำจัดศัตรูพืช

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Abatract

This cross sectional study aimed to determine health impacts of pesticide use and factors associated with pesticide exposure reduction practices among farmers in Khon Kaen. The total of 560 samples was proportional to size randomly selected from 10 villages in Muang district, Khon Kaen province. Questionnaire was used to collect the data. Both descriptive and inferential statistics were used to analyze the data.

The results indicated that 51.6% of the respondents were females with the average age of 53.2±11.9 years old, finished primary education 94.5% and 91.6% grew rice. The median time of pesticide use was 20 years. (range 1-60 yrs.), 38.8% of the farmers used more pesticides than labeled, 58.2% used pholidon (Organophosphate). Most of these farmers have never worn goggles (76.3%), the adverse affects of pesticide exposures these farmers experienced were dry throat (46.6%), dizziness (30.5%), tried (25.6%) and heavy sweating (25.4%). Factors which were statistically significant influenced the reduction of pesticide exposure behaviors ($p<0.05$) were duration of pesticide used experiences and concentration of pesticide used. Farmers who had experienced using pesticides for more than 20 yrs had 1.69 times (95% CI: 1.12-2.54) significantly more pesticide exposure reduction practices than those who had experienced fewer than 20 yrs. Those who used pesticide as was labeled had 2.33 times (95% CI: 1.53-3.54) significantly more pesticide exposure reduction practices than those who used more than the label.

It is suggested to emphasis both pesticides used and pesticides exposure reduction through the feedback of the existing of inappropriate practices, health impacts and developed appropriated knowledge, attitudes and practices in pesticides exposure reduction such as wearing protective devices and mixed pesticides as labeled. Organized training on making organic pesticide and promote it utilization in farming should be an alternative for reducing pesticide used and exposure.

Keyword : pesticide used, health risks, pesticide exposure reduction practices, health impacts of pesticide exposures

Introduction

Pesticides are substances used to prevent, destroy, repel or mitigate any pest including rodents, insects, fungi, weeds, and microorganisms, etc. (Donaldson & Grube, 2002). Pesticides are widely used in agricultural and other settings, especially importance in agriculture, vector control, and structural protection. Pesticides will continue to be used and will therefore be present in the human environment (Alavanja *et al*., 2004). Pesticides problems may be roughly categorized into a) intoxication of users; b) poisoning of non-users, directly through exposure to the pesticide or the pesticide containers, or indirectly through chronic intoxication by pesticide residues; c) production accidents; and d) environmental contamination (FAO, 2002). Exposure to pesticides may result in acute and chronic health problems. Most types of pesticides, including organophosphates (OPs), carbamate, and organochlorine insecticides as well as fungicides and fumigants, can be neurotoxic. (Keifer & Mahurin, 1997). Pesticide related health problems usually manifest as a series of symptoms depending on severity of exposure. (Iowa State University, 1995, Jinky & Del plado, 2007),

Although the developing world use only less than 50% of all the pesticides, these countries account for more than 99% of the human poisonings world wide, and every year there have been approximately 25 million cases of pesticide poisoning in the world, and at least 200,000 people die from pesticide exposure (FAO, 2002). In the case of Thailand, over the past 50 years, along with the implementation of the green revolution policy of the royal Thai government, the use of pesticides has skyrocketed (Health Systems Research Institute, 2005). In 2002, the amount of pesticides consumed in the country was 39,904 metric tons of active ingredients (World Health Organization, 2006). The estimated pesticide poisoning cases by Green World Foundation were 5,000-7,000 in 2005 (Green World Foundation, 2005). National statistics indicate that, in 2006 alone, 1,251 Thai citizens were occupationally poisoned by pesticides (Department of Disease Control, 2007). The Department of Disease Control (2004) reported case/death and mortality of pesticide poisoning between 1999-2003, as follows: 3,930/30 (6.39 per 100,000 populations), 3,109/21 (5.03 per 100,000 populations), 2,653/15 (4.27 per 100,000 populations), 2,571/11 (4.04 per 100,000 populations) and 2,342/9 (3.84 per 100,000 populations), respectively.

In Khon Kaen province, where thousands of farmers continuously use pesticides, reported cases of pesticide poisoning in 2003 was accounted for 11 individuals. (Khon Kaen Province Public Health Office, 2004) These reports showed high case/death rates of pesticide poisoning in the agricultural sector of Thailand. Given the fact that only the severe cases are reported and cases with mild symptoms goes unnoticed, the problem of pesticide intoxication surely is underestimated. Therefore this study aimed to identify prevalence, health risks, health impacts of pesticide exposures and factors associated with pesticide exposure reduction practices among farmers in Khon Kaen Province, Thailand.

Materials and Methods

This cross-sectional study was 560 households from 10 villages in Muang District Khon Kaen Province, Thailand. The proportional sample size was based on simple random sampling method. (Lemeshow *et al*., 1990)

$$n = \frac{Z^2_{\alpha/2}\, NP\,(1-P)}{d^2(N-1) + Z^2_{\alpha/2}\, P\,(1-P)}$$

Sample size from the calculation was 560 households; proportional of sample as show in table 1.

Table 1. Proportional sample in 10 villages of Muang district, Khon Kaen province.

Village/Sub-district	Total (households)	Sample (households)
Liong/ Koksi	2044	281
Nonglai/ Koksi	851	117
Bankhou	240	33
Nongvaing/ Thapra	211	29
Bungniem	167	23
Donhan/ Donhan	138	19
Sila	131	18
Pralup	124	17
Napieng/ Sumran	95	13
Thachang/ Nongtum	73	10
Total	4074	560

Structured questionnaire consisted of three parts were: (1) demographic data, (2) practices concerning pesticide use, and (3) exposure and impacts of pesticide use. The questionnaire was tested for content validity by 5 experts and for reliability which had Cronbachs' Alpha Coefficient = 0.82. The Ethical committee of Khon Kaen University approved the study (record No. 4.7.23: 12/2007; reference No. HE501040). The samples were proportional to size randomly selected from 10 villages in Muang district, Khon Kaen province. Research assistants and interviewers were trained on research context and interview techniques. Inter-observer comparisons and reflections of the observations were used to reduce observer's bias. The participants who agreed to participate in study were asked to sign the consent form before the interview. The research assistants and interviewers conducted the questionnaire interview one representative of each household. They also rechecked and edited the questionnaires for quality control before data entry. After data collection, data was scored and coded and analyzed using the STATA program. Both descriptive and inferential statistics, were used for data analysis.

Results and Discussion

From 560 villagers interviewed, 51.6% in the study was female. Their mean age was 53.2±11.9 years old, and 53.6% were 40-59 years old. The majority had only primary education (94.5%), and 83.9% was married or de facto. Their median family income was 4,000 bath/month. The Most had farmland at least 6 Rai (58.6%), 57.7% had engaged in plant cultivation for more than 50 years (range 1 to 74 years, median 30 years).

Pesticides used of the farmers

Sixty one percent of the farmers had been using pesticides for more than 10 years (range 1 to 60 years, median 20 years). The median expense for pesticide, hormone and fertilizer was 5,000 Baht (between 100-50,000 Baht). Each year 38.8% of the farmers increased the amount of pesticide used, and the reason was resistant of insects to pesticides. However, it was expensive, 75.5% reduced utilizing pesticide. Ninety two percent of the farmer grew rice, others grew vegetables such as morning glory (38.2%), lettuce (37.7%) and chili (35.4%) (Table 2).

Table 2. Farming activities and pesticide exposure (n=560)

Farming activities	Number	Percent
pesticide using in plant cultivation (years)		
≤5	81	14.5
6-10	137	24.5
11-20	142	25.4
21-30	123	22.0
31-40+	77	13.8
Mean ± SD = 19.6±12.9 yrs, Median (min, max) = 20 (1, 60) yrs		
Annual expense for pesticide, hormone and fertilizer (Baht)		
≤2000 baht	48	8.6
2001-5000 baht	239	42.7
5001-10000 baht	188	33.6
>10000 baht	85	15.2
Mean ± SD = 8,141.2±7,915.7 Baht, Median (min, max) = 5,000 (100, 50000) Baht		
Annual amount of pesticide use		
Increased the amount of pesticide use	217	38.8
Insect resistant to pesticides	105	48.4
Increasing of diseases/ insects	73	33.6
Others (Soil nourishing, Having better results)	39	18.0
Same amount... reasons	207	37.0
Having good results	182	87.9
Having small scale farming areas, Economically expense	25	12.1
Decreases the amount of pesticide use... reasons	94	16.8
More expensive	71	75.5
Others (Using liquid organics pesticides, afraid of hazardous, and using organic fertilizers and compost)	23	24.5
Irregular usage	42	7.5
Depend on kinds of plants	41	97.6
Plant which doesn't need chemical	1	2.4
Cultivated plants in this or previous seasons (could answer more than one)		
Rice	513	91.6
Morning glory	214	38.2
Lettuce	211	37.7
Others plants	198	35.4

Fifty eight percent of the farmers used Pholidon (methyl parathion), molluscicide (52.1%), and glass regulator (45.9%). They used pesticide for insect control, killed worms, and aphid control (61.1%, 60.9%, and 58.9%, respectively). Sixty nine percent to the respondents used one type of pesticide, and 31.2% used 2-3 types at a time. In term of pesticide concentration, 75.2% of the farmers used the pesticide as labeled whereas 24.8% used more than indicated in the label. The reasons for using more pesticides than indicated in the label: were resistance of the insects to pesticides (54.4%) and there were many types and numbers of insects (45.6%) (Table 3).

Table 3. Pesticides used of the farmers (n=560).

Pesticides Used	Number	Percent
Types of pesticide used in this or previous seasons (more than one answer)		
Pholidon (methyl parathion)	326	58.2
Molluscicide	292	52.1
Glass regulator	257	45.9
Other	194	34.6
Reasons for Using pesticides		
Insect control	342	61.1
Kill worms	341	60.9
Aphid control	330	58.9
Kill shellfish	319	57.0
Weed control	314	56.1
Fungicide	283	50.5
Kill ants	216	38.6
Methods of Appling Pesticides		
Used only one pesticide	385	68.8
Mixed at least 2-3 types	175	31.2
Concentration of pesticide used		
Follow the label: reasons	421	75.2
Having good outcome as label	160	38.0
Might kill plants if use more than label	93	22.1
Others (expensive and hazard of pesticide, insect may be resistant, plant outgrowth)	51	12.1
Used more than the label: reasons	139	24.8
Insect resistance to pesticide	68	54.4
Had many types and amount of insects	57	45.6

Pesticide application practices and training

Most of the farmers use backed hand pump (72.5%) followed by motor or air pump (27.0%). Forty nine percent cultivated 2-4 crops seasons/year and 32.7% did only one time/year. (During the past year, the farmer sprayed pesticide 1-50 times with the median of 3 times/year. However, 16.6 % of the farmers sprayed more than 10 times last year. In term of time interval of each spraying, 44.8% had 1-2 weeks/time (7-13 days). The median of time spent for each spraying was 60 minutes with the range of 10 to 480 minutes. The farmers sprayed pesticide both in the afternoon (68.0%) and in the morning (52.7%). Only 43.6 % used to participate in the training program on pesticide use, of which 21.1% and 20.2% were organized by pesticide companies and agriculture institutes respectively. Most of the contents in the training were pesticide utilization (84.4%), organic pesticide utilization (66.4%) and pest control (50.4%). However, most of them selected pesticide based on the recommendation of retailer (59.5%), and neighbors (42.7%) (Table 4).

Table 4. Pesticides used practices and exposures of the Farmers (n=560)

Pesticides Used Practices	Number	Percent
Equipment for pesticide spraying		
Backed hand pump	406	72.5
Motor pumping, air pumping	151	27.0
Others (e.g. Handling motor pump, Dropping, sprinkle, sowing)	63	11.3
Number of crop seasons during the past year (times)		
1	183	32.7
2-4	273	48.8
≥5	104	18.6
Median (min, max) = 2 (1, 24) times		
Number of pesticide spraying during the past year (times)		
1	106	18.9
2-4	266	47.5
≥5	188	33.6
Median (min, max) = 3 (1, 50) times		
Spacing of each spraying (days/time)		
1-6 days/time	45	8.0
1-2 week/time (7-13 days)	251	44.8
3-4 week/time (14-29 days)	71	12.7
≥1 month/time (≥30 days)	193	34.5
Median (min, max) = 10 (1, 365) days		

Table 4. Pesticides used practices and exposures of the Farmers (n=560)

Pesticides Used Practices	Number	Percent
Time spend for each pesticide spraying (Minute)		
<30-59	144	25.7
60-119	262	46.8
≥120	154	27.5
Mean ± SD = 95.2±106 Minute		
Median (min, max) = 60 (10, 480) Minute		
Period of the day which they sprayed pesticide (could answer more than one)		
Afternoon	381	68.0
Morning	295	52.7
Noon	3	0.5
Training on pesticide used during the past years		
No	316	56.4
Yes	244	43.6
From (can answer more than one)		
Pesticide company	118	21.1
Agricultural institutes	113	20.2
Public health institutes	64	11.4
Content of the training (can answer more than one)		
Pesticide utilization	206	84.4
Organic pesticide utilization	162	66.4
Pest control	123	50.4
How to select pesticide (can answer more than one can answer more than one)		
Followed the retailer advice	333	59.5
Followed neighbor advice	239	42.7
Others (e.g. direct sale staff, agriculture officer, and Self determination)	142	25.4

Pesticide exposure reduction practices.

It was found that these farmers had appropriate practices for pesticide exposure reduction such as 85.7% of them used separate clothes when spraying pesticide, washing the clothes separately, 81.8% read the instruction on the label before using new pesticides. However, many of them had somewhat inappropriate practices concerning pesticide use including: 58.4% of them always and usually ate sour fruits such as limes, tamarind and orange to drive the toxicity out of the body, 55.9% drank soda to dilute the toxicity of pesticide after spraying.

In term of exposure reduction, some of these farmers never wore glasses (76.3%), never and seldom wore mask (33.3%), gloves (33.2%) and boots (26.8%). Many of the respondents always and usually use pesticide to prevent pests to destroy crops (34.5%). Reasons why villagers prefer using pesticides were insects or diseases (63.4%), good crop yields/vegetable look good and get good prices (61.1%) and if do not use, the vegetable will not look good and will no get good prices (48.6%) (Table 5).

Table 5. Pesticides used practices and reducing exposures of the farmers (n=560).

Pesticides Used Practices	Number	Percent
Separate clothes wearing when spraying pesticide, do not washing with other clothes		
Usually and always	480	85.7
Never and sometimes	80	14.3
Read the instruction on the label before using new pesticides		
Usually and always	458	81.8
Never and sometimes	102	18.2
Eat sour fruits such as limes, tamarind and orange to drive the toxicity out of the body		
Usually and always	327	58.4
Never and sometimes	233	41.6
Drink soda to dilute the toxicity of pesticide after spraying		
Usually and always	313	55.9
Never and sometimes	247	44.1
Wear/use glasses while spraying pesticide		
Never	427	76.3
Others	133	23.7
Wear/use mask while spraying pesticide		
Usually and always	374	66.7
Never and sometimes	186	33.3
Wear/use boots while spraying pesticide		
Usually and always	406	73.2
Never and sometimes	150	26.8
Use pesticide before it destroys crops		
Usually and always	193	34.5
Never and sometimes	367	65.5

Table 5. Pesticides used practices and reducing exposures of the farmers (n=560).

Pesticides Used Practices	Number	Percent
Reasons why villagers prefer using pesticide (more than one answers)		
Insect or diseases	355	63.4
Good crop yields/vegetable look good and get a good price	342	61.1
Get a good price	272	48.6

Adverse health impact of pesticide use

Almost half of these farmers had some adverse symptoms on health such as dry throat (46.6%), dizziness/ vertigo (30.5%), weakness/exhausted (25.9%) and excessive sweating (25.4%). Additionally, some reported that they were unconscious due to pesticide poisoning (1.5%) (Table 6).

Table 6. Reported adverse health effects of pesticide use within 24 hours after pesticide spraying

Health impact	Number	Percent
Sign of pesticide toxicity within 24 hours after spraying		
Dry throat	261	46.6
Dizziness/ vertigo	171	30.5
Weakness/Exhausted	145	25.9
Excessive sweating	142	25.4
Headache	126	22.5
Burning-Stinging-Itchy eye	96	17.1
Nausea/vomiting	87	15.5
Short of breath/Cough/Breathlessness	79	14.1
Others (e.g. Itching/Skin irritation, Blurred vision, Burning nose	74	13.2
Unconsciousness	8	1.5

Factors associated with pesticide exposure reduction practices of farmers

Bivariate analysis revealed that factors associated with pesticide exposure reduction practices included were educational attainment OR = 3.0 (95% CI: 1.07 to 8.35), p = 0.03, duration of pesticides use experiences OR = 1.84 (95% CI: 1.23 to 2.73), p<0.001, concentration of pesticide use OR = 2.47 (95% CI: 1.64 to 3.73), p<0.01, training during the past year OR = 0.70 (95% CI: 0.48 to 1.0), p = 0.05, attitude on using mask during spraying pesticide will help prevent getting pesticide into the body OR = 2.23 (95% CI: 0.98 to 5.07), p = 0.05 (Table 7)

Table 7. Pesticide exposure reduction practices and factor related (n=560).

Factors	Pesticide exposure reduction practices		
	OR	95% CI	P-value
Sex	0.83	0.58-1.20	0.38
(Male = 1 Female = 0)			
Educational attainment	3.00	1.07-8.35	0.03
(> primary education = 1; primary education = 0)			
Marital status	0. 83	0.50-1.37	0.47
(married = 1; Other = 0)			
Occupation	0.43	0.13-1.40	0.17
(Agriculture = 1; Other = 0)			
Duration of pesticides used experiences	1.84	1.23-2.73	<0.001
(≥20 yrs = 1; <20 yrs = 0)			
Pesticide use pattern	0.70	0.48-1.00	0.06
(use one type = 1; mixed of 2-3 = 0)			
Concentration of pesticide used	2.47	1.64-3.73	<0.01
(as labeled = 1; more than labeled = 0)			
Training during the past year	0.70	0.48-1.00	0.05
(train = 1; no = 0)			
Knowledge on pesticide	1.24	0.86-1.79	0.23
(high = 1; low and average = 0)			
Attitude on using mask during spraying pesticide will help prevent getting pesticide into the body (agree = 1; did not agree = 0)	2.23	0.98-5.07	0.05

Multivariate analysis indicated that factors statistically significant influenced the reduction of pesticide exposure behaviors ($p<0.05$) were duration of pesticide used experiences and concentration of pesticide used. Farmers who had experiences using pesticides for more than 20 yrs had 1.69 times (95% CI: 1.12-2.54) better practices in reducing pesticide exposures than those who had experiences fewer than 20 yrs. Those who used pesticide as was labeled had 2.33 times (95% CI: 1.53-3.54) better practices in reducing pesticide exposures than those who used more than labeled. (Table 8).

Discussion

Pesticides Used of the Farmers in Khon Kaen

Most of these farmers had been using pesticides for more than 10 years (61.2%). They increased the annual amount of pesticide use (38.8%), because of insect resistance to pesticide. The farmers frequently increased the concentration of pesticide, in the belief that the increased intensities would lead to greater protection (Somluckrat, 1992). The farmers used pholidon (methyl parathion) 58.2% for insect control (61.1%), killed worms (60.9%) and aphid control (58.9%). This pesticide is highly

Table 8. Factors associated with pesticide exposure reduction practices of farmers

Factors	Pesticide exposure reduction practices				Crude OR	Adjusted OR	95% CI of Adjusted OR	*p-value*
	Low- Average (n=167)		High (n=393)					
	number	%	number	%				
Duration of pesticide used experiences								
<20 yrs	123	73.65	237	60.38	1	1		
≥20 yrs	44	26.35	156	39.96	1.84	1.69	1.12-2.54	0.01
Concentration of pesticide use								
- More than labeled	57	34.13	68	17.30	1	1		
- As labeled	110	65.87	325	82.70	2.47	2.33	1.53-3.54	<0.01

Odds ratios adjusted for Educational attainment, Duration of pesticides used experiences, Concentration of pesticide used Training during the past year and Attitude on using mask during spraying pesticide will help prevent getting pesticide into the body

hazardous and harm ful to human health. The farmers had a strong preference for pesticides which wipe out pests rapidly, thus using the most hazardous chemicals. Thai farmers used pesticides in a technologically inefficient manner (Matteson, 1996). Coupled with little knowledge about the actual effectiveness of chemicals, the described misuse of pesticides strongly suggested an overuse, i.e., technologically inefficient utilization of pesticides in Thai agriculture. The respondents used 2-3 types of pesticide at a time (31.2%), in the belief that they would provide better outcome and eliminate the increased insect resistance to pesticide. So 24.8% used more than recommendation on the label. In order to save spraying labor cost, farmers often mixed pesticides, creating a "cocktail" of several chemicals, without considering their combination possibilities. These practices increased intensity of human health adverse impact of which one major reason for farmers' chemical poisoning was their misuse of pesticides (TDRI, 1989; TDRI, 1996).

Only 43.6% of them used to join the training on pesticide use, of which 21.1% and 20.2% were organized by a pesticide company and agriculture institutes, respectively. But the training contents were pesticide utilization (84.4%), organic pesticide utilization (66.4%) and pest control (50.4%). They selected pesticide based on the recommendation of the retailer (59.5%), and neighbor (42.7%). These could lead to misuse of pesticide based on commercial propose of retailers and the pesticide company which was similar to the study of Jungbluth (1997) that farmers' decision for using pesticide is often based on information given by retailers, other farmers, extension workers and pesticide companies .

Pesticide exposure reduction practices

Many of them had inappropriate prevention concerning pesticide use, for example: 58.4% of them always and usually ate sour fruits such as limes, tamarind and orange to drive the toxicity out of the body, 57.9% drank soda to dilute the pesticide toxicity of pesticide

after spraying. In terms of exposure reduction, some of these farmers never wore goggle (76.3%), never and seldom wore mask (33.3%), gloves (33.2%) and boots (26.8%). Many of the respondents always and usually used pesticide for reduction before pests destroy crops (34.5%). High proportion of pesticide intoxications appear to be due to lack of knowledge, ignorant attitudes, and dangerous practices. The technology available to small farmers for pesticide application is often inappropriate: faulty sprayers, lack of protective equipment adapted to tropical conditions, nonexistent first-aid provisions (Forget, 1991). Farm worker in developing countries tended not to use protective measure while handling pesticide. Additional, illiteracy and a lack of proper training were the two great problems among immigrant farm workers in a desert country (Gomes *et al*., 1999). However, the study of Van der Hoek *et al*., (1998) identified that hazardous practices when spraying pesticides were due to the impossibility of applying recommended protective measures under the local conditions of customized practices, rather than the lack of knowledge such as hot climate nature (Wesseling *et al*., 1997).

Health impact from pesticide exposure

Many of these farmers had some adverse symptoms on health such as dry throat (46.6%), dizziness/vertigo (30.5%), weakness/exhausted (25.6%) and excessive sweating (25.45%). This immediate health impact confirmed the government report that there was an increasing trend of pesticide poisoning in Thailand during 1994-2003. The pesticide morbidity cases were increased from 2,342 to 4,398 cases with the rate of 3.72 to 7.16 per 100,000 populations. There were 9 to 39 persons died during the same period with mortality rate of 0.01 to 0.07 per 100,000 populations (Bureau of Epidemiology, 2005).

Factors affecting pesticides exposure reduction practices of the farmers

Duration of pesticides used had statistically significant relationships with pesticide exposure reduction practices of the farmers ($p<0.001$). The farmers who had experienced using pesticides for less than 20 years had 1.84 times higher levels of pesticide exposure reduction practices than those who had experienced using pesticides for more than 20 years (95% CI: 1.23 to 2.73). There are strong associations between the farmers' experience in health problems and the reduction in pesticide use. Experiencing a health problem influences attitudes and behavior toward pesticides, by two areas, health beliefs (whether one's beliefs about a health risk are enough to change behavior) and risk perception (Lichtenberg & Zimmerman, 1999).

Concentration of pesticides used had statistically significant relationship with pesticide exposure reduction practices of the farmers ($p<0.01$). The farmers who use higher concentration of pesticides than the recommended amount on the label had 2.47 times higher levels of pesticide exposure reduction practices than those who use the recommended amount of pesticides on the label (95% CI: 1.64 to 3.73). This studied indicated that at least 46.6% had experienced of health impact signs and symptom. The high pesticide exposure reduction practices might also be explained by the strong associations between the farmers' experience in health problems and the reduction in pesticide use, or in this case exposure, when they could not reduce the utilization. Experiencing a health problem influences attitudes and behavior toward pesticides, by two areas, health beliefs (whether one's beliefs about a health risk are enough to change the behavior) and risk perception (Lichtenberg & Zimmerman, 1999).

In conclusion, most of the farmers had been using pesticides for more than ten years and used highly toxic pesticide, pholidon (methyl parathion), which had been banned in Thailand, 31.2% used 2-3 types at a time, 24.8% used more than indicated in the label. Most of these farmers have never worn goggles (76.3%), never and seldom wore mask (33.3%), gloves (33.2%) and boots (26.8%), 34.5% of these farmers always and usually use pesticide to prevent pests to destroy crops. The adverse

health effects of pesticide exposures these farmers experienced were dry throat, dizziness, tried and heavy sweating Factors which were significantly influenced the reduction of pesticide exposure behaviors were duration of pesticide used experiences and concentration of pesticide used.

Suggestion

Relevant authorities and sectors should put more emphasis in promoting both the reduction of pesticide used among these farmers and pesticide exposure reduction practices. The strategies should reflect their inappropriate practices in pesticide use and the impacts on health of the farmers. Appropriate knowledge, attitudes and practices in pesticide exposure reduction of the farmers are essential and needed to be developed such as wearing protective devices, and use of pesticides as labeled. Liquid organic pesticides should be promoted to be used in the farms.

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