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Insecticide Application in Mushroom Farms: A Survey Study in Nongyaplong District, Phetchburi Province, Thailand

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Abstract

A survey of insecticide application behaviors of mushroom farmers in Nongyaplong district, Phetchburi province, Thailand was made during August-September, 2014. Thirty farmers were sampled who generally worked in approximately 5 mushroom houses containing about 2,000 mushroom cubes per house. The data were collected by using structured interview method. The results revealed that the most cultured mushrooms were oyster mushroom (59.3%), Jew's ear mushroom (40.5%), and others (0.2%). It was found that in general farmers used insecticides (carbaryl, methomyl and cypermethrin) for controlling insect pests (*Cyllodes* sp., *Drosophila* sp. and *Dasyses* sp.) and mushroom mites (*Luciaphorus perniciosus* and *Formicomotes heteromorphus*) by using direct spray method (57.1%). The insecticide treatments were normally conducted 3-4 times a month with 1-3 days pesticide free period before the harvests. In addition, chemical products with different trade names were generally substituted when resistance of insects or mites were observed, with no consideration of the active chemicals. Insecticide treatments were normally introduced in the morning after daily harvests, and insecticide users normally wore basic chemical protection clothing and usually well rinsed after the application. The allergic symptoms were observed, users normally evacuated from the areas, cleaned themselves, and rested. It is suggested that insecticide using behaviors of the mushroom farmers could be the background information for further studies on insecticide contamination in the mushroom products.

Keywords: structure interview, allergic symptom, insecticide contamination, carbamate

1. Introduction

In Thailand, mushroom farming has been gaining more and more interest in many areas recently. The typical species cultivated for commercial purposes are normally straw mushroom, oyster mushroom, indian oyster mushroom, abalone mushroom and Jew's ear mushroom [1]. Unfortunately, the problems related to insect and mite devastation have been causing economic impacts and losses among the mushroom farmers in many areas. The problems are therefor considered critical and need urgent resolution. Among the most important mushroom invaters are Diptera (Sciaridae, Phoridae, Cecidomyidae, Scatopsidae, Drosophilidae and Dolichopordidae famiilies), Lepidoptera (Tineidae family), and Coleoptera (Nitidulidae family) [2]. In addition, mushroom mites such as *Luciaphorus perniciosus*, *Formicomotes heteromorphus*, *Dolichocybe indica* and *Histiostoma bakeri* are also frequently found destroying the mushrooms and generally resulting in up to 20-80% losses of the on-harvest product [3].

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Regarding the urgent need for control of insects and mites on mushroom farms, chemical pesticides have been used extensively with relative incaution a bout proper amounts and methods of application. This improper application of highly hazardous synthetic pesticides has been reported, is resulting in problems for NAME pesticide user, mushroom consumers, and even the surrounding ecological system. During the years 2003-2012, the Annual Epidemiological Surveillance reported the average of 1,734 patients affected by pesticide related illness [4]. Moreover, [5] reported the contamination with carbaryl insecticides in abalone mushroom, oyster mushroom, and indian oyster mushroom, while straw mushroom were reported having the health hazardous amount of organochlorine insecticides. In addition, [5] reported pesticide residues in mushrroms from upper northeastern Thailand in 2011-2013. In particular, 15% of the observed samples were contaminated with chlopyrifos, cypermrthrin, methomyl and carbaryl, and 12.5% of the samples had higher amount of methomyl residue than the maximum residues limit (MRL) standard level.

Chemical pesticide residues have been considered presenting a great risk in long term environmental crisis [6]. Pumnuan *et.al.* [7] reported detecting chlorpyrifos and endosulfan insecticides residues in the canals connected to Neptunia plantations in Samutprakarn province, Thailand. In addition, Chaigarun *et. al.* (2013) [8] reported the contamination of carbosulfan insecticide in soil and water in 4 northeastern provinces, Thailand. In general, pesticide users recognize the possible dangers of pesticides on their health and environmaent. However, they normally lack knowledge of safe application and protection methods. Thus, the users generally risk themselves accumulating lethal pesticides and having fatal health problems unknowingly. In many cases, the patients were reported suffering vchronic symptoms with observable immediate effects as mentioned on the pesticide product lables Ruangchai & Inmuong, 2013. In particular, a report of [4] mentioned that over 90% of the patients were diagnosed affected by unidentifiable pesticides, while the others (less than 10%) were reported suffering organophosphate carbamates and other pesticide symptoms.

Regarding the improper application of chemical pesticides and possible hazards of pesticides on the users, consumers, and the environment, this study aimed to investigate pesticide application behaviors of mushroom farmers in Nhongyaplong district, Petchburi province, Thailand, in order to build up background information on possible problems related to improper pesticide application behaviors and draw up possible recommendations for future investigations regarding the resolutions and protection of possible hazardous situations caused by inappropriate application of mushroom pesticides.

2. Materials and Methods

This study was a quantitative research using survey oriented method, interview techniques. The subjects were 30 mushroom farmers in Nhongyaplong district, Petchburi province, Thailand, selected by purposive sampling method. The data were collected using interview techniques in August-September 2014, and analysed using frequency, percentage, mean score, minimum, maximum, and standard deviation in SPSS program.

The interviews were divided into 3 parts including;

1. Demographic information: close-ended question involving name, sex, marital status, education, income, and working experience.

2. Mushroom farming information: close-ended question involving farming space, size and number of mushroom houses, production cost, mushroom species, problem and solution, and observable mushroom insects and on-harvest mushroom management.

3. Pesticide application behaviors: close-ended question involving pesticide sources, using reasons, frequencies, pesticide free periods, using methods, insect resistance management, self-protection procedures, and observable symptoms.

3. Results and Discussion

3.1 Average Demographic information

Most of the respondents in this study were female (73.3%) and 90% were married. The general level of education was primary school. The average salary was 5,000-20,000 THB/month, and the average mushroom farming experiences were 5-10 years (Table 1). However, it could not be concluded from the obtained information that most mushroom farmers were women. Mushroom farming in the area was the family business. The interviews were conducted during the day time when men usually went out for farm work. Consequently, the interview respondent were housewives who normally worked at home. In addition, it was found from the interviews that mushroom cultivation was introduced to the area 20 years ago. This information described why the farmers that they had 5-10 years experience in mushroom cultivation.

3.2 Mushroom farming

The results showed that 92.9% of the farmers generally ran mushroom farms on their own lands, with approximately 5 mushroom houses on each farm (83.4%) and normally 2 mushroom species were cultivated. In addition, it was found that a mushroom house contained approximately 2,001-2,500 cubes (60%). The most cultivated mushroom species were oyster mushroom (96.7%) and Jew's ear mushroom (93.3%) with the average production cost at 10,001-20,000 THB/year/house. Moreover, all the farmers encountered problems involving mushroom pests, mushroom diseases, weeds, poverty, and unsuitable environment. The higher devastating pests included Drosophilidae (100%), Tineidae (93.3%) and ants (50.0%). In addition, *L. perniciosus* (83.3%) and *F. heteromorphus* (66.7%) were also found. The farmers generally used pesticides in the pest management (90.0%). In particular, the frequently used pesticides included carbaryl, methomyl, cypermethrin and chloptrifos. Medicinal plants were also alternately applied in the pest management (60.0%). It was also found that the post-harvested cubes of Jew's mushroom were normally mixed with other materials in producing cubes for oyster mushroom cultivation, mixed with manure, or simply discarded as leftover (Table 2).

The mushroom production in Nhongyaplong district, Petchburi province was relatively considered as medium-sized cultivation with approximately 2,000-2,500 cubes per mushroom house. In addition, the area was generally suitable for multi-species cultivation, since this located in the mountain-sided lower land, and mushrooms could be cultivated throughout the year. The farmers reported the highest pest invasion as related to *Scatopse* sp. (Scatopsidae). However, this finding was incongruent with the report of [3] which suggested the invasion of *Lycoriella* sp. (Sciaridae), *Megasellia* sp. (Phoridae) and *Heteropeza* sp. (Cecidomyidae). It was possible that the farmer mistook these flies for *Scatopse* sp., since the flies generally look similar but *Scatopse* sp. are generally larger. In particular, this study reported 100% observation of *Scatopse* sp., while only 13.3% of other flies were mentioned.

3.3 Pesticide using behaviors

It was found in this study that almost all farmers (90%) applied chemical pesticide in the management of mushroom pests. Generally, the pesticides were purchased from neighboring grocer's stores (81.4%) and suppliers (40.7%). The reasons for using chemical pesticides were mainly based on their immediate effects, convenience, availability, and recommendation of the community leaders. The average application frequency was 3 times a month (37.0%) with 1-3 days exemption before the harvests. Particularly, 55.5% of the farmers reported the 3 days exemption (Table 3). This finding was in congruence with the pesticide application behaviors of water mimosa farmer in Samutprakarn province. It was reported in the study that 55% of the famers purchased chemical pesticides from neighboring grocers' stores. The famers usually asked for recommendations from the grocers with the belief that they were more skillful and had more knowledge and experience [9]. Normally, the lack of pre-harvest exemption of pesticides could result in the residues in fresh produce For example, [10] reported 89.4% of residues detection in fruits and vegetables in Surathani province, and 75.4% detection were also found in local vegetables in north-eastern Thailand [8], but only 19.1% in GMP fruit and vegetable application[11].

In the current study, it was also reported that the farmers generally read the application guidelines on the products (100%), and cleaned themselves well after the applications (100%). Most of the pesticide users (96.2%) wore protection outfits (insecticide users normally wear basic chemical protection clothing; cotton mask, long sleeved shirt and long trousers). In addition, 81.4% of the users reported no pesticide related symptoms, while 29.6% reported non-serious health effects. When resistances were observed, the famers usually changed the products with references to the active chemicals (81.4%), while 18.5% implemented the application of other products or medicinal plants to supplement the performance of the in-use pesticides (Table 3). The findings were similar to the report of [12] about the health impacts of pesticide on tobacco farmers in Kalasin province, Thailand which revealed that 61.8% of the users had nonfatal symptoms like dizziness (61.8%) and headache (56.4%). The symptoms were reported as related to direct contact with organophosphate and carbamates [13]. In the current study, it was found that the farmer normally lack knowledge about the development of insect resistance, chemical standards, and the combination of pesticides.

Table 1. Demographic information of mushroom cultivation in Nhongyaplong district, Petchburi province, Thailand. (n=30)

Demographic information	**Average percentage**
1. Sex	
Male	26.7
Female	73.3
2. Marital status	
Single	10.0
Married	90.0
Divorced	-
3. General level of education	
Lower than grade 6	3.3
Primary school	70.0
Lower secondary school	10.0
High school	0.0
Diploma	13.3
Bachelor Degree	3.3
4. The average salary THB/month/family	
< 5,000 THB	6.7
5,001 – 10,000 THB	30.0
10,001 – 15,000 THB	33.3
15,001 – 20,000 THB	20.0
> 20,000 THB	10.0
5. Professional experience in mushroom farming	
< 5 years	13.3
5-10 years	26.7
11-15 years	40.0
> 15 years	20.0

Table 2. Information on the mushroom farming in Nhongyaplong district, Petchburi province, Thailand. (n=30)

Information of mushroom farming	Average percentage
1. Cultivation area	
Own lands	92.9
rentals	7.1
2. Number of mushroom houses	
< 5 houses	46.7
5-10 houses	36.7
11-15 houses	13.3
> 15 houses	3.3
3. Size of mushroom houses	
< 1,500cubes per houses	10.0
1,501 - 2,000 cubes per houses	10.0
2,100 - 2,500 cubes per houses	60.0
> 2,500 cubes per houses	20.0
4. Mushroom species (Answer more than 1)	
Yanagi mushroom	3.3
Oyster mushroom	96.7
Jew's ear mushroom	93.3
5. Production costs per houses	
< 10,000 THB	10.0
10,001 – 20,000 THB	66.7
20,001 – 30,000 THB	16.7
> 30,000 THB	6.6
6. Problem and solution in mushroom cultivation(Answer more than 1)	
Insects and mites	100.0
Mushroom diseases	100.0
Not flowering	100.0
Weeds	100.0
Weathers	100.0
7. Observable mushroom insects and mites (Answer more than 1)	
Formicomotes sp.	66.7
Histiostoma sp.	3.3
Dolichocybe sp.	16.7
Luciaphorus sp.	83.3
Scatopse sp.	100.0
Thysanoptera	3.3
Formicidae (ant)	50.0
Coleoptera	26.7
Larvae of lepidoptera	93.3
Diptera (*Lycoriella* sp., *Megasellia* sp., *Heteropeza* sp.)	13.3
8.Management of insects and mites in mushroom (Answer more than 1)	
Biological control	0.0
Pesticides	90.0
Medicinal plant extracts	60.0
Cultural	7.1
9. Pesticides 1. Carbaryl 3. Methomyl 2. Cypermethrin 4. Chlorpyrifos	

Table 2. Information on the mushroom farming in Nhongyaplong district, Petchburi province, Thailand. (n=30) Con.

Information of mushroom farming	Average percentage
10. Post-harvested cubes management 1. Normally mixed the post-harvested cubes of Jew's ear mushroom with other materials in producing cubes for oyster mushroom cultivation 2. Mix with manure 3. Discard	

Table 3. Information on the pesticide using behaviors in Nhongyaplong district, Petchburi province, Thailand. (n=30)

Information on the pesticides using behaviors	Average percentage
1. Sources of pesticides (Answer more than 1)	
Local store	81.4
Sales	40.7
2. Using reasons (Answer more than 1)	
Immediate effects	62.9
Convenience	62.9
Preference proposed by community leaders	44.4
Buy easy	44.4
3. Frequency	
1. Time	26.0
2. Times	22.2
3. Times	37.0
4. Times	14.8
4. Pre-harvest exemption	
0 day	0.0
1 day	26.0
2 days	18.5
3 days	55.5
> 3 days	0.0
5. Application	
Read the application guidelines	100.0
Take into account the harvesting period	25.9
Using more protection outfits	96.2
Cleaned themselves after applications	100.0
6. Protection - cotton mask - long sleeved shirt - long trousers	
7. Reaction to resistance	
Changed the product (Regardless of name)	81.4
The other compounds were mixed (Regardless of name)	18.5
The use of herbal mixed with chemicals	18.5
8. Symptoms of toxicity from the use of pesticides health effect	
Non observable effects	81.4
Not severe symptoms such as nausea, vomiting, dizziness, drowsiness, muscle aches, fatigue, sweating more than usual.	29.6
Severe allergic reactions such as fainting and senseless	0.0

4. Conclusions

This study provided basic information about the pesticides using behaviors of mushroom farmers in Nhongyaplong district, Petchburi province, Thailand. Most farmers were uneducated about dealing with chemicals used, self-protection from those harmful insecticides, insect resistance as well as use of medicinal plants as green insecticides. Therefore governmental agency should urgently inform the famers about the information mentioned above via the head of those communities. Insecticides used by farmers seem to be the most critical subject due to their heavy application without concern for pre-harvest exemption. Many mushrooms were contaminated and caused serious health effect. Further study regarding, the insecticide residue in mushrooms distributed in the markets is needed.

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