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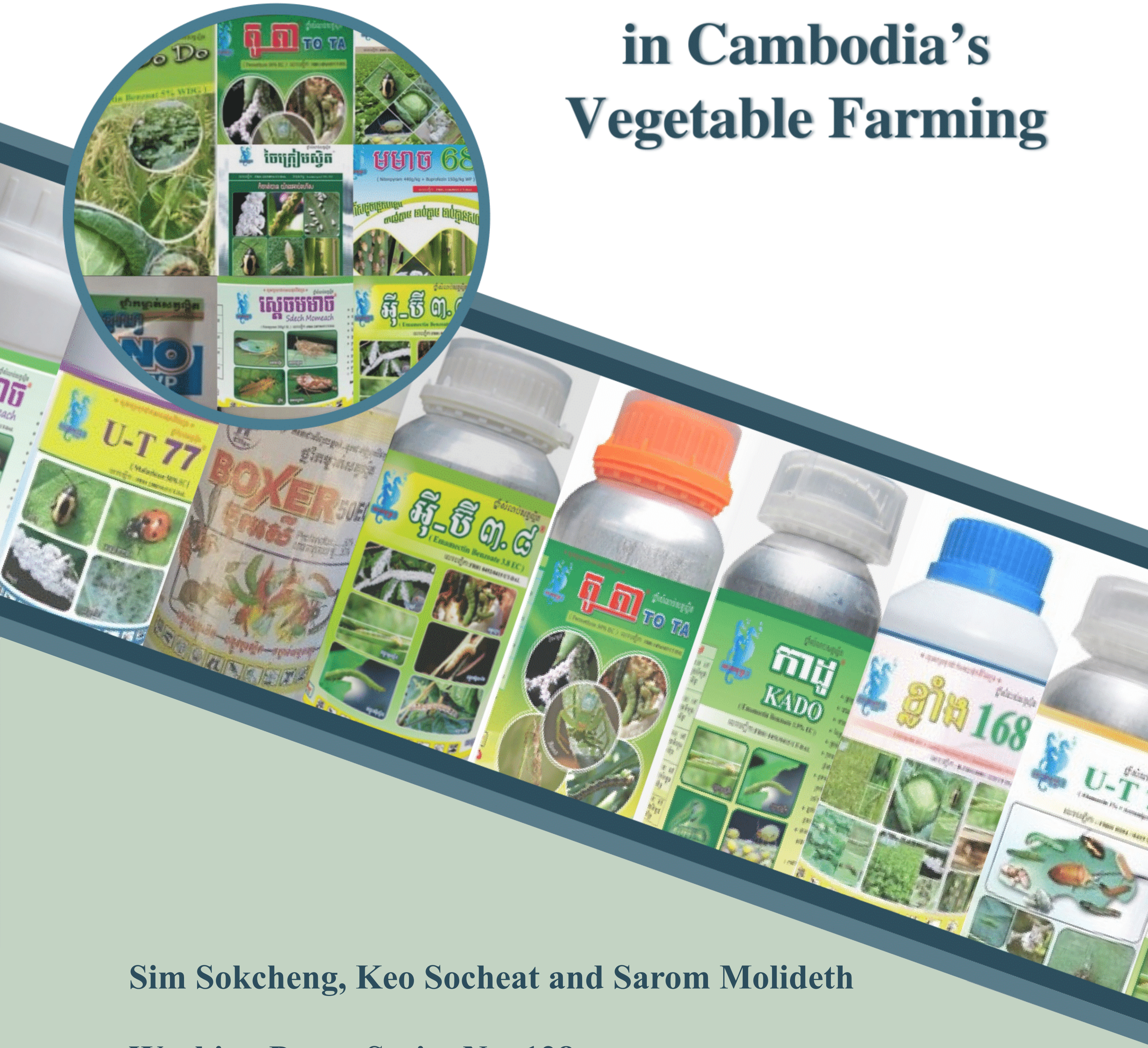
Pesticide Use Practices in Cambodia's Vegetable Farming



Sim Sokcheng, Keo Socheat and Sarom Molideth

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Acronyms

BFP	Boosting Food Production Program
CamGAP	Cambodian Good Agricultural Practices
GAP	Good Agricultural Practices
MRL	maximum residue level
OLS	ordinary least squares
RUA	Royal University of Agriculture
WHO	World Health Organization

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Abstract

Pesticides are agricultural technologies that farmers use to control pests and weeds and remain an important modern input for crop production including vegetable farming. There are many types of pesticides, such as insecticides, fungicides, rodenticides and herbicides, that target different threats to crops. While the potential production benefits of chemical pesticides are undeniable, people are becoming more aware of their risks. There is an array of dangers associated with inappropriate pesticide use. As pesticides are a poison, they pose inherent health risks to the farmers exposed to them. Inappropriate pesticide use has been linked with pesticide residues in or on food above maximum residue levels (MRLs), the safe amount of residue allowed, which can cause a number of health effects in those who consume the products. Our survey data reveals that pests and diseases are the biggest challenge Cambodian vegetable farmers face. Pesticides/herbicides account for the largest share in vegetable production costs in our study areas, suggesting that chemical pesticides are commonly used in vegetable farming in Cambodia, particularly our study areas which are the main producers of vegetables in the country. Additionally, it is common that farmers mix various types of pesticides per spray which is not good practice.

Applying ordinary least squares regression and probit model, we investigated the factors that facilitate or impede pesticide use practices. The results show that lower use of pesticide is associated with age of farmers in charge of pesticide spraying, educational attainment, female farmer, and varied by locations. At the same time, there is a significant link between the use of large quantities of pesticide and farmers' misperception of pesticide use practices and the proportion of pesticide spending in total input costs. Apart from this, knowledge/advice about pest management/control farmers receive from their peers and pesticide stores, household participation in social groups such as agricultural cooperatives, and farm size are positively correlated with the probability that a farmer will comply with recommended pesticide doses. These results imply that modifying farmers' attitudes towards pesticide use and promoting the role of women in vegetable pest management are among the important interventions to reduce pesticide dependence.

1. Introduction

Green revolution technologies, which include fertilisers, improved crop varieties and pesticides, have transformed agricultural production since the late 1960s through productivity improvement (Ogada, Mwabu and Muchai 2014). To maximise crop yield, pesticides are considered an important component of these technologies for effective and reliable crop protection against pests and diseases (Mengistie, Mol and Oosterveer 2017). The use of pesticides in agriculture has markedly increased in developing countries, especially in Southeast Asia. Cambodia is no exception, with annual growth in pesticide use in 2003–12 of about 61 percent (Schreinemachers et al. 2015). This significant increase implies unsafe pesticide use or misuse which poses health risks to pesticide applicators and consumers. For instance, a 2017 study on pesticide use among smallholder vegetable farmers in Southeast Asia found that residue levels on 33 percent of vegetable and fruit exports from Vietnam to four European countries exceeded maximum residue limits (MRLs) (Schreinemachers et al. 2017).

Although agriculture is one of the important driving forces for the country's economic resilience and development, approximately 70 percent of fresh fruits and vegetables in Cambodia are imported. This is largely because domestic commercial production of vegetable crops has been consistently inadequate (USAID 2015). Vegetable farming accounts for only 2 percent of the temporary crop[1] area, and the domestic supply of vegetables is so seasonal and limited that consumers turn to produce imported mainly from Vietnam and Thailand to address the local supply shortfall. The demand for locally grown vegetables would be higher and domestic production could even substitute for imports from Vietnam and Thailand if Cambodia's fresh vegetables met food safety and quality assurance standards.

Chemical pesticides, since their invention nearly a century ago, have had a profound impact on global agriculture. There are now many different types of pesticides, including insecticides, fungicides, rodenticides and herbicides, that target different threats to crops. While the potential production benefits of chemical pesticides are undeniable, people are becoming more aware of their risks. A wide array of potential hazards has been associated with the inappropriate use of pesticides. Pesticides are poisons, and they pose inherent health risks for farmers and farmworkers who are exposed to them. These range from headaches, excessive sweating and dizziness to vomiting, muscle twitching and even unconsciousness (Schreinemachers et al. 2017). Inappropriate pesticide use is often linked with residue levels in or on food exceeding the MRLs, the safe amount of residue allowed, which can cause illness in those who consume the products. MRL exceedances are commonly cited as the reason why few farmers are able to export their produce, as most importing countries have stringent MRL requirements (NIER 2015). Pesticide misuse can take many forms but the most common are over-spraying, failure to use protective equipment, non-compliance with the minimum time interval between the last spray and harvest, mixing different types of pesticides in the same spray tank without checking compatibility, and incorrect use of yellow (highly toxic) and red (extremely toxic) coded pesticides.

Pesticides are agricultural technologies that farmers use to control pests and weeds and constitute an important modern input for crop production including vegetable farming (Kateregga 2012). The common determinants of farmers' decision to apply pesticides include availability of complementary inputs, access to agricultural extension services, social networking, household

1 Crop with a less than one-year growing cycle.

wealth, credit and market accessibilities, land rights, off-farm income, socio-demographic characteristics and agro-ecological location of farm households (Feder, Just and Zilberman 1985; Nkonya, Schroeder and Norman 1997; Matuschke and Qaim 2008).

Little is known about pesticide use practices in Cambodia. For example, Jensen et al. (2011) studied pesticide handling practices and self-perceived poisoning among 89 pesticide sprayers in Boeung Cheung Ek, Phnom Penh. Two results stand out: 50 percent of the pesticides sprayed are in the harmful category of the WHO Recommended Classification of Pesticides by Hazard, and sprayers' education is positively associated with reduction in the risk of poisoning. A recent study by Schreinemachers et al. (2017) investigated the determinants of pesticide application practices among 900 farm households producing leaf mustard and yard-long beans in Cambodia, Laos and Vietnam. They used the amount of pesticide applied per hectare per week as the proxy for pesticide handling practices. Their empirical evidence shows that farmers have poor knowledge about pesticide use; advice from friends and neighbours is negatively associated with lower pesticide use, but advice from pesticide stores encouraged farmers to use more pesticides; and women's participation in pest management decisions can significantly reduce the amount of pesticide used.

So far, no extensive research has been done on vegetable farming in Cambodia. Previous empirical studies neither specifically addressed on-farm food safety risks in the vegetable subsector nor used rigorous econometric modelling and analysis (see, for example, NIER 2015; USAID 2015; CPS 2016; Jensen et al. 2011). To the best of our knowledge, only one empirical study – Schreinemachers et al. (2017) – has investigated the determinants pesticide use practices among Cambodian farm households, specifically those growing leaf mustard and yard-long beans. However, because that study used a non-representative sample, the results cannot be generalised to the situation of vegetable farming throughout Cambodia. Essentially there have been no studies documenting detailed records on pesticide use by Cambodian vegetable farmers.

Albeit scant, research evidence points to the importance of ensuring on-farm food safety in Cambodia's vegetable production. This study on the pesticide use practices of vegetable farmers intends to build on previous research and contribute to filling the knowledge gap in this field by using survey data collected from Cambodia's four main vegetable producing provinces. The study findings can inform the design of agricultural policy for commercial-scale production and import substitution strategy, thereby contributing to broader agricultural development.

With the aim of contributing to agricultural development through the promotion of safe vegetable farming, our study uses empirical methodology and cross-sectional survey data to understand pesticide use practices in Cambodia's vegetable production. Specifically, we (1) apply ordinary least squares (OLS) regression to estimate the determinants of average pesticide use per hectare, and (2) use probit model to examine the factors significantly associated with the probability of compliance with pesticide dosage regimes. The survey was conducted in 2018 and administered to 600 vegetable farming households across 33 villages (25 communes) in the four main vegetable growing provinces of Battambang, Kandal, Kampong Cham and Tboung Khmum.

The rest of this paper is organised as follows. Pesticide use in Cambodia's vegetable farming is presented in Section 2, followed by a review of the literature in Section 3 evaluates empirical research studies on pesticide use practices, particularly in vegetable production. The conceptual framework and empirical specification including data and descriptive statistics are detailed in Section 4. Section 5 presents and discusses the empirical findings, and Section 6 concludes and provides some policy implications.

2. Pesticide use in Cambodia's vegetable farming

Vegetables are a key part of the Cambodian diet, with more than 96 percent of the population eating vegetables 4.8 days per week. Yet vegetable farming accounts for only 1.3 percent of total agricultural land (NIS 2015; FAO 2014), which is partly because the vast majority of vegetable farmers are smallholders with an average landholding of 0.41 ha (Schreinemachers et al. 2017).

The vegetable sector is still dominated by fruit-bearing and leafy vegetables (NIER 2015), though the specific vegetables that are grown and consumed have changed dramatically in the last two decades. The most commonly grown vegetables by cultivation area, according to the Census of Agriculture 2013 (NIS 2015), are cucumber (7,000 ha, chilli (5,000 ha) and pumpkin (5,000 ha). A different study (CPS 2016) found that the most commonly sold vegetables by retailer are cucumber (32 percent), Chinese cabbage (16 percent), tomato (13 percent), cauliflower (11 percent) and Chinese radish (11 percent).

Vegetable markets in Phnom Penh predominately rely on local produce from Phnom Penh, Kandal, Kampong Speu, Takao, Kampong Cham and Kampong Chhnang as well as substantial amounts of imports. Neak Meas, Deumkor, Suong and Samaki markets together absorb as much as 278 tonnes of vegetables a day (CPS 2016), However, domestic vegetable supply is only able to meet 40 percent of domestic vegetable demand. The annual national vegetable supply amounts to 0.42 million tonnes, less than half of the 0.93 million tonnes demanded every year (NIER 2015), leaving a huge supply gap for vegetable importers to exploit. Vietnam is the main supplier of vegetables to Cambodia as its vegetable crops are more reliable and therefore cheaper than Cambodia's, though it is unlikely that Vietnamese vegetables are any safer than Cambodian vegetables as they rarely undergo food safety inspections.

Different countries have different classification systems for pesticide toxicity, but all are based on the WHO Hazard Classification system. Table 1 shows a truncated version of the WHO Classification of Pesticides by Hazard, published by the Royal University of Agriculture (RUA 2003). Some countries distinguish between Class 1a and Class 1b, where Class 1a represents the most toxic pesticides, but this distinction is omitted as Cambodia does not differentiate between the two.

Table 1: WHO Classification of Pesticides by Hazard

WHO Hazard Classification	Hazard category	Colour code	mg/kg dose (Liquid, solid)
Class 1	Toxic	Red	1–50
Class 2	Harmful	Yellow	50–200
Class 3	Caution	Blue	200–5000
Class 4	Unlikely to present a hazard in normal use	Green	5000+

Source: RUA 2003

There is a wide array of dangers associated with inappropriate use of pesticides. Pesticides are poisons and they pose inherent health risks to the farmers and farm workers who are exposed to them. Health effects range from headaches, excessive sweating and dizziness to vomiting, muscle twitching and even unconsciousness (Schreinemachers et al. 2017). Inappropriate pesticide use is often linked with residues on or in food that exceed the MRL, which can cause illness in those who consume the products. MRL exceedances are commonly cited as the reason why few farmers are able to export their produce, as most importing countries have strict MRL (NIER 2015). Pesticide misuse can take many forms, but the most common are over-spraying, failure to use protective equipment, non-compliance with the minimum time interval between the last spray and harvest, mixing different types of pesticide in the same spray tank without checking compatibility, and incorrect use of yellow (highly toxic) and red (extremely toxic) coded pesticides.

Cambodia does not manufacture its own pesticides. Chemical pesticides are mainly imported from Vietnam and Thailand along with some from China and the EU. Cambodia's pesticide imports are growing at an estimated annual rate of 61 percent compared to 55 percent for Laos and 10 percent for Vietnam (Schreinemachers et al. 2017). Pesticides that are imported legally must follow Cambodia's quality and labelling laws and are therefore typically less hazardous and have packaging translated into Khmer. Illegally imported pesticides, on the other hand, are typically more dangerous and have labels written entirely in the language of the country of origin. To ensure that farmers are better aware of these risks, the government has organised training on pesticide best practices and has implemented a Khmer labelling system for pesticides so that farmers can be better informed of the recommended dosage and associated risks of the pesticides they purchase.

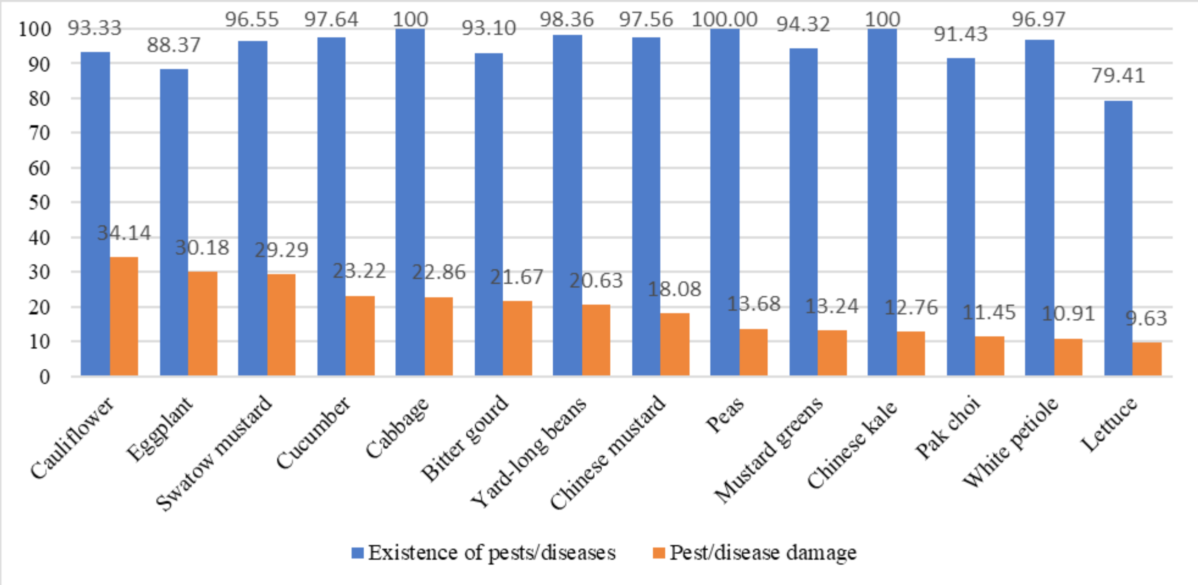
A crucial aspect of pest management is knowledge. This is especially true for chemical pesticides given the health risks they pose. Unfortunately, there is a lack of knowledge on how to use these products safely and correctly. Farmers have developed a number of dangerous habits when using pesticides. These include over-spraying and spraying unnecessarily toxic pesticides in the mistaken belief that good pesticides are those that kill all insects immediately (Schreinemachers et al. 2017). These practices increase farmers' exposure to pesticides and also increase pesticide residue levels on the produce and the land itself. The most dangerous habit that farmers have formed, however, is mixing different types of pesticide in the same applicator. These so-called pesticide "cocktails", which average 3.7 pesticides in a single spray, are mixed and sold in local pest control shops based on farmers' description of the problem. These shop owners are rarely trained professionals, contrary to the requirements of Cambodia's Good Agricultural Practices (CamGAP), so are unable to mitigate the dangers of mixing pesticide types. These chemical cocktails not only increase the risk to farmers' health, but also increase pests' resistance to chemical fertilisers, forcing farmers to use more pesticides and more dangerous pesticides to kill the same number of pests (Schreinemachers et al. 2017). Even though farmers typically have general knowledge of harmful arthropods, they struggle to identify beneficial species, meaning they waste pesticides on killing helpful arthropods. Finally, a commonly held mistaken belief among vegetable farmers is that illegally imported pesticides are more effective and genuine as they look more foreign than their registered counterparts (Schreinemachers et al. 2017).

Regarding information about pest management practices and pesticide use, farmers seek advice from local pesticide shops, friends and neighbours, as well as from government extension workers. However, the most influential and common source of information is their local pesticide shop (Schreinemachers et al. 2017). In addition, those who seek advice from local pesticide shops tend to use more pesticides than those who seek advice from friends and neighbours.

2.1. Perceived effects of pests and diseases

It has been well documented that pests and diseases are the biggest challenge that Cambodian smallholder vegetable farmers face. As Figure 1 shows, pests and diseases had a severe effect on vegetables grown in the cycle before the survey was conducted. On average, farmers found pests or diseases on 95.14 percent of the vegetables grown during the last cycle. All of the 600 farm households found pests or diseases on their cabbage, peas and Chinese kale. Additionally, the survey found that on average 20 percent of crops grown during the last cycle were damaged by these pests and diseases, with vegetables such as cauliflower, eggplant and Swatow mustard suffering losses of more than 30 percent.

Figure 1: Vegetable pests and diseases commonly found by farmers and the damage caused to crops (percent)



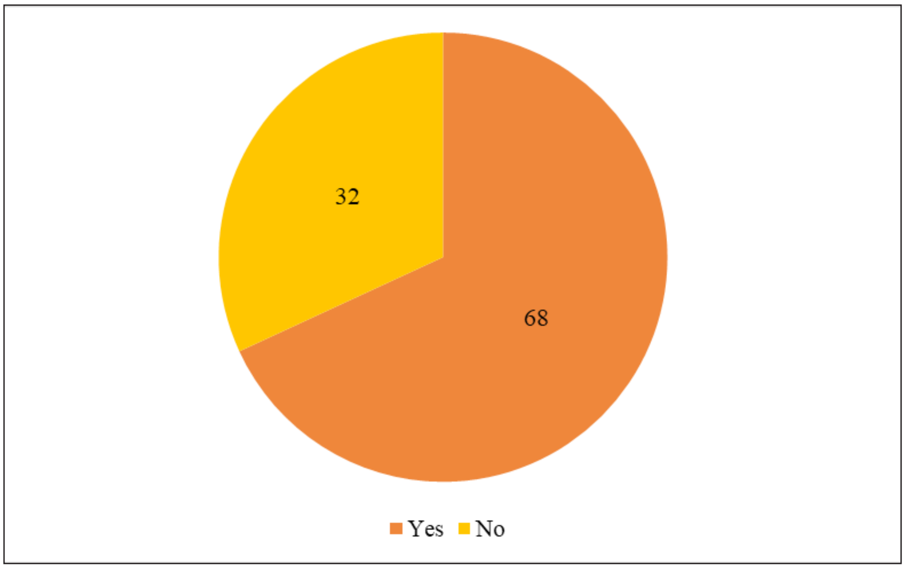
Source: Calculation based on the household survey

2.2. Pesticide dealers and wholesalers

We conducted eight key informant interviews with pesticide wholesalers to gain some insights into the supply of the pesticides used by the surveyed vegetable farmers. It was found that farmers have easy access to a wide range of chemical inputs at the local markets in their district and commune. In some cases, those products are even available at retail stores in their villages. Vietnam, Thailand and China were the main sources of pesticides sold by these wholesalers. Most products are imported by registered agricultural input distributors, demonstrated by the authorisation labels visible on the packages. Pesticides from these sources could help minimise the risks of pesticide misuse – which is hazardous to humans and the environment –given that all essential information is translated into Khmer. Presumably, unauthorised pesticides were also present in these same stores. This assumption is based on the lack of authorisation labels on the packaging and the lack of Khmer translation for any of the information (Figure 2).

Six of the eight pesticide dealers interviewed in the four provinces had not participated in any training on pesticides before starting their businesses. Of these eight, only one shop owner in Battambang had received training from the District Office of Agriculture. He, however, was not always present at the shop, leaving the trading and consultations to untrained shopkeepers. This lack of official training among pesticide dealers is worrisome because farmers typically consult these dealers in lieu of trained personnel about effective pesticide usage.

Figure 2: Pesticides with Khmer instructions (percentage)



Source: Calculation based on the household survey

There are two groups of pesticide buyers that frequent these shops. The first group includes farmers who source pesticides based on previous experience. In this case, they ask dealers for pesticides from specific brands or from familiar companies that have worked well in previous applications. The second group consists of farmers without prior knowledge of pesticides. Pesticide dealers play the role of consultant for these farmers, selecting and mixing pesticides based on information that the farmer provides. These mixtures typically consist of three types of pesticides; in some cases, pesticide dealers recommend mixtures of five different types. This practice goes against CamGAP codes, whose standards recommend using only one type of pesticide in each spray unless advised by trained personnel. Guidance by a trained professional is critical as they understand the ramifications that inappropriate use of pesticides can have on farmers and the food system as a whole.

2.3. Toxicity of pesticides available

A total of 372 different types of agrochemical inputs, consisting mainly of insecticides, fertilisers and disease control substances, were identified throughout the four provinces. Of these insecticides, 156 are highly toxic, represented by a yellow label, 74 are moderately toxic, thus labelled blue, and 10 are less harmful, labelled green (Table 2). It is worth mentioning that not all of the products for sale carried the necessary information written in Khmer. Based on our observations, up to 39.3 percent of all products identified across the four provinces do not have information and instructions translated into Khmer. This lack of translation can lead to misuse of the products, which may result in negative impacts on both humans and the environment. It was also discovered that a very small number of farmers in Battambang, Kampong Cham and Tbong Khmum are still using extremely toxic (red label) pesticides, even though these pesticides have been banned by the Ministry of Agriculture, Forestry and Fisheries.

In Battambang, 62 different pesticides were available, 37 of which are highly toxic, 18 moderately toxic, and four less harmful (Table 2). In Kandal province, 92 different insecticides were collected, 53 of which are classified as highly toxic, 22 as moderately toxic, and 12 as less harmful. In Tboung Khmum and Kampong Cham, 121 different insecticides were collected. Of these, 66 are highly toxic and 34 are moderately toxic. In each province, there was also a small number of pesticides that could not be identified.

Table 2: Observed pesticides by type in each province

Area	Insecticide	Disease control substances	Growth booster	Herbicide	Total
Battambang	62	7	16	0	87
Kandal	92	7	25	3	130
Kampong Cham and Tbong Khmum	121	7	23	0	155
Total by category	**275**	**21**	**64**	**3**	**372**

Source: Calculation based on household survey

Table 3: Hazard level of the observed insecticides by province

WHO Classification	Battambang	Kandal	Kampong Cham and Tboung Khmum	Total
Red	1	0	2	3
Yellow	37	53	66	156
Blue	18	22	34	74
Green	4	12	16	32
Unidentified	2	5	3	10
Total by province	**62**	**92**	**121**	**275**

Source: Calculation based on household survey

Of the 21 disease control substances discovered in the four provinces, all but one is moderately toxic or less harmful. In Battambang and Kandal, disease control substances were almost exclusively moderately toxic, whereas disease control substances in Kampong Cham and Tboung Khmun were more evenly distributed.

2.4. Use of pesticides

Nearly 99 percent of surveyed farmers used chemical pesticides and fertilisers on some or all of their vegetables. The remaining 1 percent use non-chemical techniques to grow some or all of their vegetables.

The cost structure of vegetable farming from our household survey is reported in Table 5. On average, vegetable farmers spent around 40 percent of total input expenditure on pesticides and fertilizers (25 percent and 15 percent respectively). This result suggests that pesticides/herbicides account for the largest share in the input expenditure of vegetable farming in our study areas.

Table 4: Vegetable production techniques used by the surveyed farmers

Types of vegetable farming techniques	Number of Cases	Percent of total sample
Normal (chemical pesticides, fertilisers)	599	98.84
Use of net (net house)	5	0.83
Organic	1	0.17
Natural (no chemical pesticides/ fertilisers)	1	0.17
Total	606	100

Source: Calculation based on household survey

Table 5: Input expenditure per cycle

Input	Average cost (riel)	Share of total cost (percent)
Pesticides/herbicides	431,721	24.71
Other labour	328,222	18.78
Chemical fertilisers	253,771	14.52
Gasoline	151,816	8.69
Seed/seedlings	145,083	8.30
Soil preparation (ploughing, harrowing, bed raising, mulching)	124,565	7.13
Land rental	103,138	5.90
Bamboo sticks and ropes (for staking)	93,700	5.36
Plastic bags, trays or containers	70,215	4.02
Labour in pest management (hired)	23,270	1.33
Compost/organic fertiliser	3,403	0.19
Others	2,507	0.14
Lime	1,882	0.11
Irrigation (pump, water purchase, drip system)	852	0.05

Source: Calculation based on household survey

In line with this, our survey data indicates that farmers clearly prefer chemical pesticides over biopesticides, with the vast majority spraying only chemical pesticides (Figure 3). In addition, the majority of farmers prefer mixing many pesticides in one application rather than using just one at a time as recommended (Figure 4). Thirty-five percent of farmers mixed up to three different types of pesticides in a single spray and another 15 percent mixed up to four types. Only 11 percent of farmers used one pesticide per spray.

Figure 3: Vegetable farmers using bio and chemical pesticides (percent)

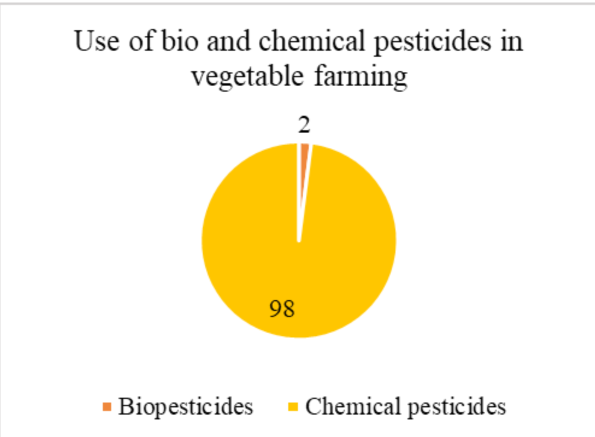
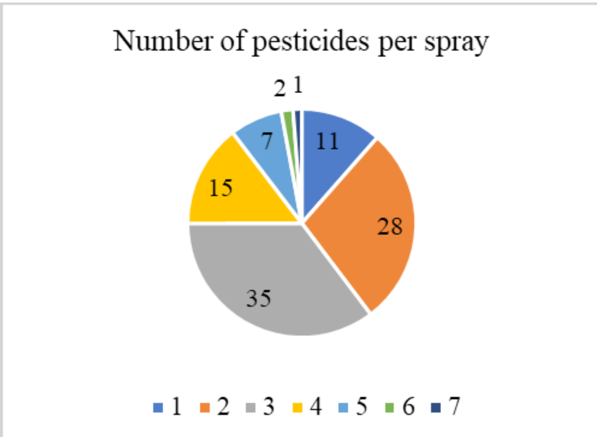


Figure 4: Vegetable farmers mixing different types of pesticides in one spray (percent)



Source: calculation based on household survey

As Table 6 shows, farmers who chose to use pesticides sprayed nearly every crop that they grew. All farmers using chemical pesticides sprayed their crops of bitter gourd, cabbage, Chinese mustard, Swatow mustard and kale, and the vast majority of them sprayed their other vegetable crops, except for lettuce (79 percent). The use of biopesticides is not common among the surveyed vegetable farmers in the study provinces. In addition, the survey data reveals that on average farmers mixed three different types of pesticides together in a single spray, which is not safe for farmers and consumers from a technical perspective.

Table 6: Percentage of crops sprayed by farmers who used pesticides

Vegetable	Use of chemical pesticide (%)	Use of biopesticides (%)	Number of pesticides mixed in one spray
Swatow mustard (60 days)	100.00	3.45	3.34
Chinese mustard (40 days)	100.00	4.88	3.05
Cabbage (90 days)	100.00	5.56	2.93
Chinese kale (60 days)	100.00	0.00	3.59
Bitter gourd (150 days)	100.00	6.90	3.24
Cucumber (80 days)	99.21	3.15	2.63
Yard-long bean (90 days)	98.36	1.64	3.05
Cauliflower (90 days)	98.33	3.33	2.29
Eggplant (90 days started from plant)	97.67	4.65	2.88
Bok choy (40 days)	97.14	4.29	3.07
White petiole (40 days)	96.97	6.06	3.31
Mustard green (40 days)	96.59	7.95	2.89
Peas	94.74	0.00	3.17
Lettuce	79.41	0.00	2.04

Source: Calculation based on household survey

Farmers reported a number of reasons for mixing pesticides, but the main reason cited was that they wanted to target many pests (Table 7). This indicates the perception among farmers that using various types of pesticide together per spray is an effective way to deal with pests.

Table 7: Farmers' reasons for mixing pesticides

Reason	Percent of total households
Many pests	87.03
Only one pest but uncertain about pesticide effectiveness	6.09
Following the suggestions of others	4.38
Imitating other applicators	2.03
Other reasons	0.47

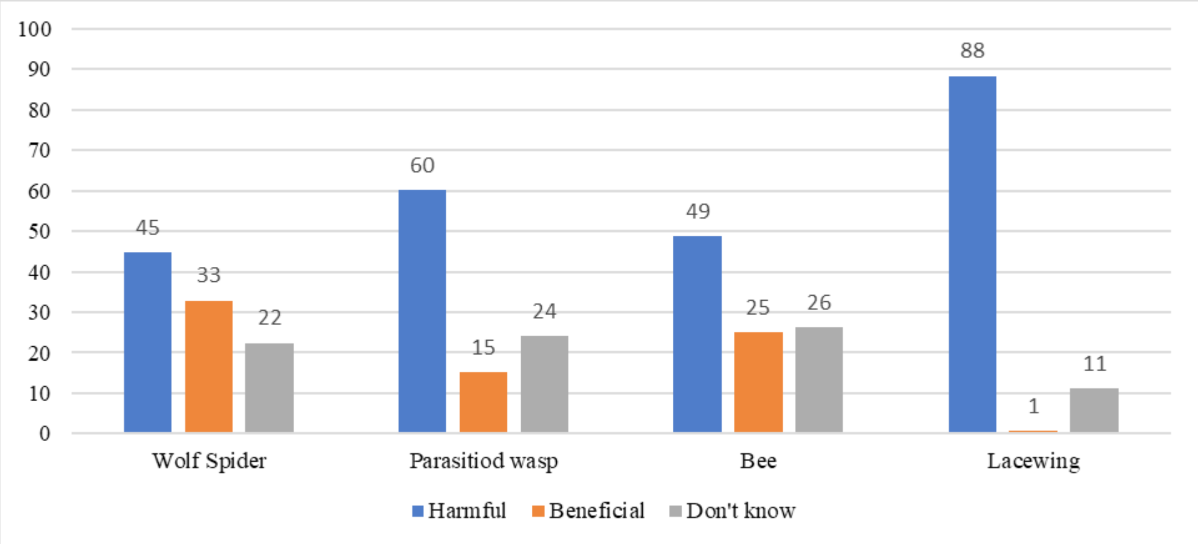
Source: Calculation based on household survey

2.5. Farmers' knowledge of pesticides

Before farmers can spray pesticides on their crops, they first must know which pests and diseases are affecting their crops. Annex 1 shows the wide array of pests that can be found on vegetable crops. The most common pest identified across all crops was dangkov yol tong/rom. This pest accounted for nearly 38 percent of all of the pests identified by the surveyed farmers. The next most common pests were Teak Ku and Kra plern/sor/inflame, which accounted for 8.3 percent and 6.0 percent of all pests respectively (Annex 1). All other pests represented less than

5.0 percent of total pests. The quantity of pests present depended on the vegetables that were being grown. For example, more than half (55 percent) of the pests were found on mustard greens (17 percent), cucumber (16 percent), cabbage (12 percent) and bak choy (10 percent).

Figure 5: Farmers' ability to identify beneficial insects



Source: Calculation based on household survey

Our survey data indicates that more than 20 percent of farmers could not differentiate between harmful and beneficial species. Almost 90 percent of them believed that lacewings are harmful to their crops and only less than 10 percent thought otherwise. Similarly, higher percentages of farmers misjudged wolf spiders, parasitic wasps and bees as being harmful rather than beneficial (Figure 5). When this result was further observed, it was clear that farmers were familiar with identifying harmful insects and struggled to identify beneficial ones. Also, farmers were not noticeably better at identifying arthropods common to any specific vegetable, indicating that the inadequacy of knowledge about that is common among farmers.

Farmers are not only reliant on their own knowledge; there is a wide network that they can use to gather information and advice on pest management. The data in Table 8 shows that most of the surveyed farmers received information related to their pest and disease problems from various important sources such as local pesticide shops (52 percent) and friends and neighbours (37 percent).

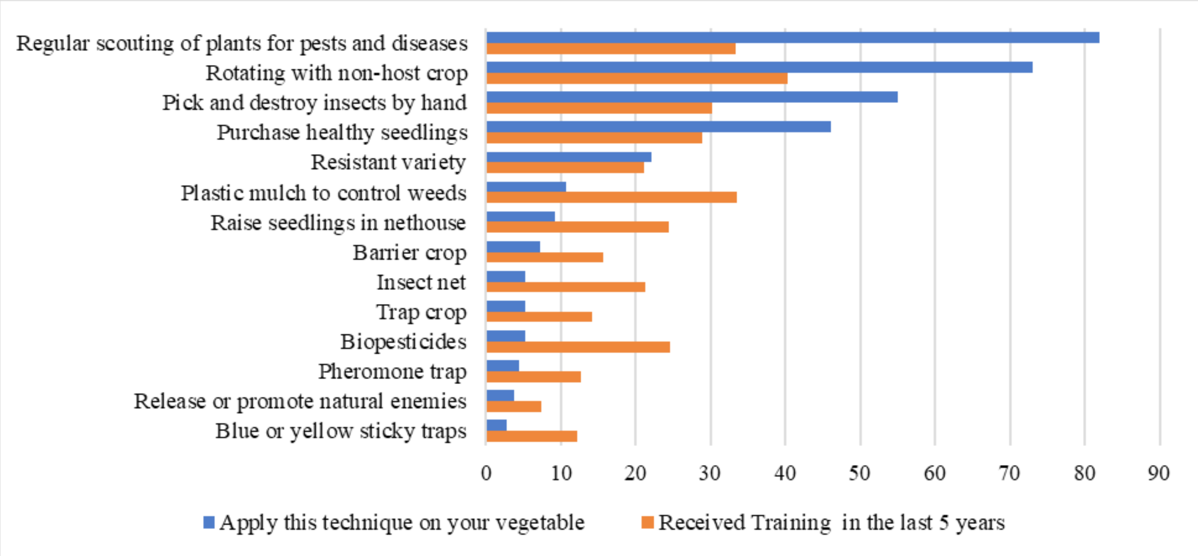
Table 8: Sources of information for pest and disease problems

Source of information	Percentage
Pesticide shop	51.83
Friend or neighbour	36.53
Lead farmer	4.09
Extension office or official	3.77
NGO	2.91
TV program	0.75
Other	0.11

Source: Calculation based on household survey

Farmers also have had access to training in pest management techniques (Figure 8). Of the 14 alternative techniques that were referenced by farmers, the most commonly adopted are "regularly scouting plants for pests and diseases" (82 percent), "rotating with non-host crops" (73 percent), and "picking and destroying insects by hand" (55 percent). These training programs appear to be highly effective, given that the four most commonly used pesticide-alternative techniques are also the ones which are most widely taught.

Figure 6: Pest management techniques used and training received (percent)



Source: Calculation based on household survey

When it comes to the reasons why farmers did not apply the improved farm practices that they learned, our survey data indicates that more than three quarters of them reported the high cost of raw materials (30 percent), their habits (24 percent) and additional time requirements (22 percent) as barriers to adoption. The main sources of their knowledge about these improved farm practices are social networking (i.e., neighbours, friends or relatives) and extension services provided by NGOs and extension officials from the Provincial Department of Agriculture (Table 9).

Table 9: Reasons why farmers do not implement the techniques taught in training

Reasons	**Percent**
High cost of raw materials	30.29
Habit	23.51
Time consuming	22.46
Other	5.38
Have tried, but unsuccessful	4.21
Instructions are complicated	4.09
Training not useful	3.86
Raw materials not available locally	3.51
Don't understand about the instructions	2.69

Source: Calculation based on household survey

3. Literature review

This section provides a literature review of the empirical research on pesticide use practices, particularly in vegetable production, supporting the empirical specification and analysis of this study. Pesticides are agricultural technologies that farmers use to control pests and weeds, and they remain an important modern input for crop production including vegetable farming (Kateregga 2012). The common determinants of farmers' decisions to use those agricultural technologies include availability of complementary inputs, access to agricultural extension services, social networking, household wealth, credit and market accessibilities, land rights, off-farm income, socio-demographic characteristics and agro-ecological location of farm households (Feder, Just and Zilberman 1985; Nkonya, Schroeder and Norman 1997; Matuschke and Qaim 2008).

A study by Mengistie, Mol and Oosterveer (2017) used a social practice approach through in-depth interviews and observations from a sample of farmers, pesticide suppliers and relevant governmental officials to examine pesticide use practices among smallholder vegetable farmers in the Central Rift Valley of Ethiopia. The results show that farmers did not comply with the recommendations for safety and storage facilities. For instance, farmers used more than the recommended dosage in the mistaken belief that a higher dosage means more effective pest control. The study suggests that to improve the situation of pesticide use practices, there is a need for additional or new actors such as environmental authorities, private sector agencies and NGOs along with social and technological innovations. Similarly, Macharia, Mithöfer and Waibel (2013) examined the determinants of pesticide handling practices by vegetable farmers in Kenya based on a survey of 425 households conducted in 2008. Their econometric results indicate that pesticide handling practices were significantly determined by record keeping of pesticide uses, sources of knowledge or information about pesticide use from pesticide traders, and geographical location.

Schreinemachers et al. (2012), using farm-level survey data on horticultural production in northern Thailand, examined whether the fruit and vegetable farmers who adopted the GAP introduced by the government used fewer types or lower amounts of pesticides than the farmers who did not follow the GAP standards. Their quantitative and qualitative evidence indicates that GAP had no effect on reducing pesticide use, mainly because of the poor auditing mechanism of the GAP program and because farmers were not well aware of the logic of the control points for the application of GAP standards. This study suggests that there is a need for a greater effort to improve on-farm pest management rather than focusing too much on testing farm produce for pesticide residues.

Van Hoi et al. (2009) studied pesticide distribution and use in vegetable farming in the Red River Delta in Vietnam using a survey of 125 farmers. Their findings show that farmers' decisions to select and use pesticides were influenced by their technical knowledge, their thoughts about risks related to pest management and perceptions of pesticide toxicity. This study implies that to realise the goals of safe vegetable farming programs, the government should consider removing inexpensive pesticides (the ones with high toxicity) from the market, training farmers on how to select and use pesticides according to technical standards and encouraging more participation from other actors.

Adjrah et al. (2013) studied the attitudes and practices of 150 vegetable farmers in Togo with a focus on pesticide application. Their survey results indicate that most of the farmers did not receive training on pesticide use and failed to pay attention to or follow the recommended pre-harvest interval. And the study suggests that pesticide use practices in the study area are not safe for farmers and consumers.

Galt (2008) examined the factors that affect pesticide use intensity among vegetable farmers in Costa Rica using a survey of 148 farmers engaged in potato and squash production. Pesticide use intensity for this study is defined as the amount of pesticide, in kilograms, that farmers sprayed per hectare per week. The empirical results from ordinary least squares regression suggest that farm household characteristics, political-economic networking, and agro-ecological conditions are the significant determinants of pesticide use intensity.

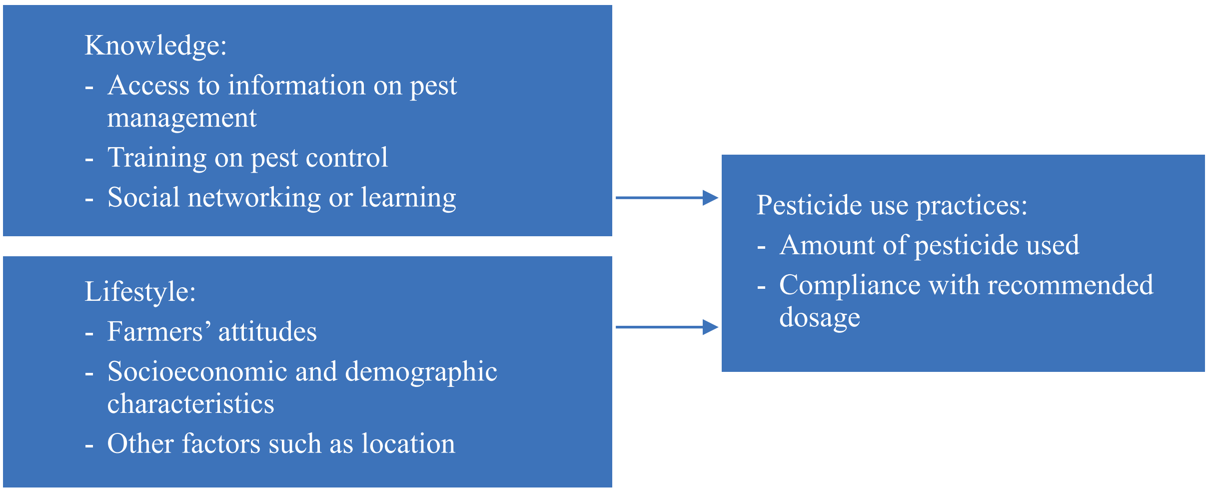
Little is known about pesticide use practices in Cambodia. For example, Jensen et al. (2011) studied the pesticide handling practices and self-perceived poisoning among 89 pesticide sprayers in Boeung Cheung Ek, Phnom Penh. Their results reveal that 50 percent of the pesticides sprayed are in the harmful category of WHO, and sprayers' education is positively associated with reduction in the risk of poisoning. Additionally, a recent study by Schreinemachers et al. (2017) investigated the determinants of pesticide use practices among 900 farm households producing leaf mustard and yard-long beans in Cambodia, Laos and Vietnam. The amount of pesticide used per hectare per week is the proxy for pesticide handling practices. Their empirical evidence shows that farmers have limited knowledge about pesticide use, and that advice from friends and neighbours is negatively associated with lower levels of pesticide use, but advice from pesticide stores encourages the use of more pesticides; and women's participation in pest management can significantly reduce the amount of pesticide used.

4. Conceptual framework and empirical specifications

4.1. Conceptual framework

This subsection briefly conceptualises farm households' decisions to use pesticides in vegetable production. Subsequently, we explain the conceptual framework for the factors, including the adoption of improved farm practices, that are hypothesised to have a significant linkage with farm households' decisions to use pesticides. From a theoretical perspective, a farmer chooses a set of improved farm technologies including pesticides to maximise the expected utility of profit conditional on the decision to use them (Feder and O'Mara 1981; Ogada, Mwabu and Muchai 2014). In our study, a vegetable farm household chooses to apply a certain amount of pesticides if the expected utility of profit with this application is higher than other pesticide application methods.

Figure 7: Conceptual framework



Source: adopted from Schreinemachers et al. 2017

The conceptual framework for our study is based on the theoretical perspectives and modification of Schreinemachers et al. (2017) and Mengistie, Mol and Oosterveer (2017), which applied the framework of knowledge, lifestyle (including attitudes) and practices (Figure 7). That is, knowledge and lifestyle are hypothesised and are the two main categories of factors that can facilitate or impede pesticide use practices among vegetable farm households. In this framework, "practices" refers to farmers' actual pesticide use practices such as amount of pesticide used, compliance with recommended dosage, and number of pesticides combined in one spray.

Knowledge draws on farmers' access to information about improved farm practices for pest control management in vegetable farming. In this regard, communication – a process in which farmers generate and share information – is an important component of the diffusion of innovations through certain channels such as media and interpersonal interactions (Rogers 2003). To deal with that constraint, farmers engage in learning-by-doing, experimenting with a modern input or agricultural technology to reveal the tacit elements of the technology. Besides, farmers might learn either from other farmers such as extension agents or friends and neighbours. Hence, this category of determinants of pesticide use practices implies the importance of knowledge acquisition, its sources and its application.

Attitudes is a part of lifestyle, and it refers to how farmers perceive pesticide effectiveness, including their misperceptions of pesticide use practices (Schreinemachers et al. 2017). For instance, if farmers believe that mixing various pesticides together is an effective form of pest management, they will probably use higher amounts of pesticides than those who believe otherwise. Additionally, farmers' lifestyles are reflected in the socioeconomic characteristics of farm households and the person responsible for vegetable farming such as income, education, age, gender and household size (Mengistie, Mol and Oosterveer 2017). For example, farmers with good education tend to have the ability to think analytically and use information about pesticide application more effectively.

Institutional factors such as availability of an agricultural development program, regulatory framework and monitoring system are also significant determinants of pesticide use practices in a country. That is, weak regulatory enforcement and the lack of monitoring of pesticide risk makes it difficult to manage the widespread use of pesticides, as is the case in Cambodia, Laos and Vietnam (Schreinemachers et al. 2015).

The agro-ecological location of farm households plays an important role in modern input use and pest management (Kassie et al. 2013), because each location may have different soil types, rainfall patterns and pest types, which require different pesticide application methods. In practice, household location, including province or zone, can be used as an alternative indicator for agro-ecological location.

4.2. Empirical methodology

To examine the determinants of pesticide use practices, which is the main objective of our study, we first need to define the dependent variables. After reconciling the available information from survey data and the literature on pesticide use, (e.g., Schreinemachers et al. 2017; Macharia, Mithöfer and Waibel 2013; Mengistie et al. 2017), we choose two dependent variables to include in the model based on what other researchers have done.

The first dependent variable is defined as the amount of pesticide in kilograms per hectare per week that a household used for a particular vegetable. To estimate this variable, we asked farmers to report by each vegetable they grew: (1) the names of all the pesticide products used in a production cycle; (2) the quantity of each product used per spray; (3) the number of times the product was sprayed, (4) cultivated land size; and (5) the duration (number of days) of the last farming cycle. The data is collapsed from pesticide level to make vegetable-level data so that this dependent variable can capture the number of pesticides that farmers mixed together per spray.

The second dependent variable is defined as 1 if a particular pesticide use was compliant with the recommended dosage shown on the product label; 0 otherwise. More specifically, it is defined as 1 if the quantity of a pesticide that a farmer used was equal to or less than the instructed amount. This dummy variable is estimated at the pesticide level, and products without recommended dosage are dropped from the empirical analysis for the second regression. The third dependent variable is also a dummy which is defined as 1 if the pesticide container has a green label or a blue label, which are lower hazard bands than yellow and red labels. Hence, the second and third regressions have a binary dependent variable (1 or 0).

When it comes to econometric specification, because our first dependent variables are continuous and binary, we specify the empirical models based on this. To examine the determinants of the quantity of pesticide used, we use ordinary least squares (OLS) regression which is expressed in the following matrix form:

$$Y_i = X_i \beta + u_i \quad \text{(Equation 1)}$$

where i is the observation running from 1 to n; Y_i represents continuous outcome variables (for amount of pesticide in kilogram per hectare per week); X_i is a set of independent variables including plot and household characteristics; β is vector of parameters associated with the independent variables; and u_i is an error term. To control for vegetable heterogeneity (14 types of vegetables), we also include vegetable dummies in our regression model. Plus, the standard error in the regression estimation is clustered at village level to ensure that it is robust for making inference, because there is potential for intra-village correlation of dependent variables of households in the same village (Saing 2018).

For the second and third regression models, the dependent variables are binary. Wooldridge (2008) and Baum (2006) suggest that when the dependent variable is binary, either probit or logit regression is used to predict the probability of the dependent variable being 1. It should be noted that it is not clear that probit performs better than logit or vice versa. The probit model for adoption of new technology can be represented in Equation[2] (2)

$$P(dummy = 1) = \Phi(h(\mathrm{H})) \quad \text{(Equation 2)}$$

The model can be derived from introducing a latent variable Y_i^*, which is defined as:

$$Y_i^* = X_i \beta + \varepsilon_i \quad \text{(Equation 3)}$$

In practice, one cannot observe Y_i^*, but instead one observes Y_i, which takes the values of 1 if $Y_i^* > 0$, and $Y_i = 0$ if $Y_i^* \leq 0$. Also, vegetable dummies and clustered robust standard error are applied to the second and third regressions models.

4.3. Data

This study used data from the vegetable farming household survey conducted in 2018 in four provinces. The survey was administered to 600 farm households across 30 villages (26 communes) in 17 districts (Table 10) from Battambang, Kandal, Kampong Cham and Tboung Khmum provinces which are home to Cambodia's main vegetable growing areas and have the potential to expand vegetable production to meet domestic needs.

The four provinces were identified through the market survey of vegetable sellers. Vegetable growing villages of each province were then identified using the commune database. 30 villages were randomly selected from the identified village list and confirmed by preliminary field visit. Finally, 20 households were systematically selected per village using the village household list.

Table 10: Sample size

Province	Number of districts	Number of communes	Number of villages	Number of households
Battambang	9	10	10	200
Kampong Cham	3	6	7	140
Kandal	4	8	10	200
Tboung Khmum	1	2	3	60
Total	**17**	**26**	**30**	**600**

2 The model is adopted from Barslund and Tarp (2008)

4.4. Descriptive statistics

The dependent variables vegetable- and pesticide-level are summarised in Table 11. As mentioned in the empirical specification part, there are two dependent variables. The first one is the amount of pesticide in kilograms per hectare per week that a household used for a particular vegetable, and we collapsed the data from pesticide- to vegetable-level to capture the total quantity of pesticides and the number of different pesticides that farmers mixed together per spray for a particular vegetable. The second dependent variable is estimated at pesticide level, and is defined as 1 if the quantity of a pesticide that a farmer used in a spray was equal to or less than the recommended dose.

Table 11: Summary statistics of dependent variables by vegetable

Dependent variables	1-Quantity of pesticide/ha/week (vegetable level)			2-Compliance with dosage (pesticide level)		
Vegetable	Mean	Std	N	Mean	Std	N
Mustard greens (40 days)	3.84	3.64	71	0.42	0.49	166
Swatow mustard (60 days)	2.68	2.40	29	0.47	0.50	77
Chinese mustard (40 days)	2.91	3.45	37	0.38	0.49	85
Bak choy (40 days)	4.02	3.70	61	0.36	0.48	190
White petiole (40 days)	4.71	4.18	29	0.36	0.48	58
Cabbage (90 days)	2.76	2.95	78	0.54	0.50	185
Chinese kale (60 days)	3.74	2.57	15	0.42	0.50	38
Cauliflower (90 days)	1.94	1.86	55	0.45	0.50	99
Bitter gourd (150 days)	3.50	4.05	23	0.64	0.48	70
Cucumber (80 days)	3.00	3.70	113	0.58	0.49	224
Yard-long beans (90 days)	3.16	3.76	44	0.30	0.46	104
Eggplant (90 days)	3.15	3.80	38	0.64	0.48	64
Lettuce	2.20	2.50	27	0.47	0.50	49
Peas	5.11	3.70	14	0.21	0.42	42
Total	3.20	3.44	634	0.46	0.50	1,451

Source: calculation based on household survey data

As Table 11 shows, cucumber, cabbage and mustard greens are the top three vegetables planted by farm households in our sample. The average quantity of pesticide that farmers sprayed per hectare per week is 3.84 kg, and the top three vegetables in terms of quantity of pesticide used are peas (5.11 kg), white petiole (4.71 kg) and bak choy (4.02 kg) (Table 11). It should be noted that farmers mixed an average of three pesticides together in a single spray, which is comparable to the findings of a previous study (Schreinemachers et al. 2017).

The average rate of farmer compliance with the recommended pesticide dosage per spray is 46 percent (Table 11). We could not find information about recommended dosage for some pesticides, so the number of observations (pesticides) for this variable decreased to 1,451. Further, on average, our data shows that 40 percent of the pesticides used by farmers had either green or yellow labels (i.e., less hazardous). The rest of section summarises the independent variables listed in Table 12 that we use in our regression models, which are supported by our conceptual framework.

Household socioeconomic and demographic characteristics, which include age, gender, schooling of the person in charge of vegetable production, household size, annual income and assets, are a part of lifestyle which is hypothesised to influence pesticide use practices in our study. The average age (reflecting experience) of persons in charge of farming is 45 years, 18 percent of them are female, and their average years of schooling is around 6 (Table 12). Plus, household size – which represents the availability of labour supply – is around 5.

Chemical pesticides are modern inputs which are usually purchased, so farmers need capital to get them. Farm size and household asset index, which are the proxies for household wealth in our study, are also conceptualised to have significant linkage with farmer pesticide use practices (Teklewold, Kassie and Shiferaw 2013). Our data indicates that the average planted area for vegetable farming is 0.27 hectares, and most of the farm households rely on vegetable farming as the main source of income. In the absence of price information for each pesticide, we use the proportion of pesticide spending to total input expenditure, and our data shows it accounts for 24 percent of vegetable production costs.

We also choose a number of independent variables to reflect the means of communication and knowledge about pest management. As shown in Table 12, our survey data indicates that 15 percent of the vegetable farm households participated in agricultural groups. Regarding sources of knowledge about pesticide use, most of the farmers acquired knowledge from friends and relatives (45 percent) followed by pesticide stores (14 percent). Another important independent variable represents farmers' attitudes – misperception of pesticide use practices. That is, 76 percent of farm households in our sample believed that mixing various pesticides together is an effective form of pest management (Table 12).

Table 12: Summary statistics for household characteristics (588 households) by province

Variables	Definition	Mean	SD
age	age of the person in charge of vegetable production (years)	45.14	10.94
female	1 if the person in charge of vegetable production is female; 0 otherwise	0.19	0.39
schooling	years of schooling for the person in charge of vegetable production	5.8	3.15
belief_mixedpst	1 if the respondent believes mixing various pesticides per spray is effective; 0 otherwise	0.76	0.43
knw_boosting	1 if household received technical knowledge or training on pest management over the last five years from BFP; 0 otherwise	0.09	0.28
knw_peers	1 if household received technical knowledge or training on pest management over the last five years from friends or neighbours; 0 otherwise	0.45	0.5
knw_store	1 if household received technical knowledge or training on pest management over the last five years from a pesticide store; 0 otherwise	0.14	0.34
asset index	Household asset index estimated by principal component analysis in STATA	0.01	1.18
prop_pesticide	proportion of pesticide spending to total input expenditure (percentage)	24.02	15.13
prop_veginc	proportion of vegetable annual income to total annual income (percentage)	58.38	28.89
agr_group	1 if farmer participated in an agricultural group or cooperative; 0 otherwise	0.15	0.36
veg_land	Total vegetable production area (hectare)	0.27	0.33

Source: calculations based on household survey data
Note: BFP stands for Boosting Food Production program

5. Empirical findings

The objective of this study is to analyse the factors that influence pesticide use practices in vegetable farming, and we have two regression models as explained in the empirical specification part. The coefficients for the probit regressions in Table 13 are reported in terms of average marginal (partial) effects for a convenient interpretation. That is, a parameter estimate is the expected probability that a unit change in variable X will result in the outcome variable Y equalling 1, with other independent variables held fixed (e.g., Baum, 2006; Mathenge, Smale and Olwande 2014; Olwande et al. 2015). Also, as there are 14 types of vegetables, we control for differences in vegetable types or heterogeneity by including the vegetable dummies in the regression models, but we do not report and interpret the coefficients on the vegetable dummies. Additionally, the F-value for the OLS model and chi-squared statistics for the probit model are statistically significant at the 1 percent level, suggesting that the null hypothesis that all independent variable coefficients for the three regression models equal zero is rejected (Table 11).

The results show that a one year increase in the age of the person responsible for vegetable farming, on average, is statistically associated with a reduction in pesticide use of 0.042 kg per hectare per week, at the 1 percent significance level, holding other factors in the regression model fixed. Age can represent farmer experience of farming, as indicated in previous empirical studies in Cambodia and other countries in the region (Schreinemachers et al. 2017). This implies that older farmers are more risk averse and have better pesticide-handling practices than their younger counterparts. This could be because they have more exposure than the younger ones to farm technologies and have better social capital. On the other hand, age has no significant linkage with the probability of complying with recommended dosages and using less hazardous pesticides.

On average, around 0.92 kg less pesticide was used when a woman was responsible for vegetable farming including pest management than when a man was responsible for it. The coefficient is statistically significant at the 5 percent level. This finding is consistent with that of an empirical study conducted in Cambodia, Laos and Vietnam by Schreinemachers et al. (2017) and a study on pesticide handling practices by Kenyan vegetable farmers (Macharia, Mithöfer and Waibel 2013). This finding reinforces the role of women in vegetable pest management in Cambodia, so training on improved farm practices such as integrated pest management should not overlook gender as an aspect.

Regarding educational attainment, which is an indicator for human capital, pesticide use was negatively assiciated with the famer's years of schooling. That is, for each extra year of schooling, weekly pesticide use per hectare decreased by 0.10 kg, at the signficance level of 5 percent. Usually, farmers with higher education are more aware of how to apply new knowledge and of the potential costs associated with excessive pesticide use. This result can contribute to and enrich the findings of recent research by Schreinemachers et al. (2017) because they did not empirically examine the relationship between farmers' schooling and pesticide use practices.

Furthermore, farmers' attitudes and misperceptions about the use of chemical pesticides are positively associated with the amount of pesticide used and is statistically significant at the 1 percent level. This finding supports what we hypothesised in the conceptual farmework. That is, pesticide use per hectare is around 0.8 kg higher when a farmer believes that mixing various pesticides together is an effective form of pest management. This finding is consistent with the previous studies which indicated that farmers' misperception of pesticide effectiveness leads to unsafe pesticide use, and it also reinforces the idea that farmer attitude plays an important role in pesticide use practices (Schreinemachers et al. 2017; Mengistie, Mol and Oosterveer 2017).

Table 13: Regression estimation results of the determinants of pesticide use practices

	OLS regression (vegetable level)	Probit regression (pesticide level)
Variables	Amount_ha_week	Compliance
		Marginal Effects
age	-0.0417***	-0.00104
	(0.0136)	(0.00153)
female	-0.918***	0.0564
	(0.333)	(0.0481)
schooling	-0.118**	-0.00545
	(0.0446)	(0.00511)
belief_mixedpst	0.533**	-0.0207
	(0.236)	(0.0431)
knw_boosting	0.263	-0.142**
	(0.449)	(0.0651)
knw_peers	-0.0476	0.0776**
	(0.334)	(0.0364)
knw_store	-0.230	0.0986*
	(0.489)	(0.0525)
asset_index	0.0505	0.0180
	(0.104)	(0.0121)
prop_pesticide	0.0350**	-0.00123
	(0.0147)	(0.00144)
prop_veginc	5.69e-05	-0.000443
	(0.00552)	(0.000538)
agr_group	-0.480	0.198***
	(0.330)	(0.0547)
veg_land	0.115	0.220***
	(0.515)	(0.0669)
Battambang	-1.368***	-0.0408
	(0.315)	(0.0568)
Tbk_Kampch	-2.760***	0.158***
	(0.388)	(0.0546)
Constant	6.539***	
	(0.920)	
F-value	71.32***	
Observations	634	1,451
R-squared	0.198	

Source: Calculation based on household survey data
Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

It should be noted that sources of knowledge about pest management/control do not have a significant relationship with the amount of pesticide used. They do, however, have a positive relationship with the probability that a farmer will comply with recommended pesticide dosages.

We obtained mixed results for this indicator. That is, the farmers who received training on pest management through the Boosting Food Production (BFP) program are 14.2 percent less likely to comply with the recommended dosage, and it is statistically significant at the 5 percent level. A possible explanation is that BFP does not necessarily focus on coaching the farmers to apply pesticides in compliance with the recommended dosage. On the other hand, the probability of compliance was around 7.7 percent higher when farmers acquired knowledge about pest management or control from their friends or relatives and around 9.9 percent higher when they acquired it from pesticide stores.

This abovementioned finding can contribute to the study by Schreinemachers et al. (2017) which did not examine the determiants of farmers' compliance with recommended pesticide dose rates. We can explain this finding from the perspective of social learning, that farmers can learn how to use improved farm technology from others. That is, farmers are more positive about the application and profitability of new farm technology based on the experience of their neighbours. Similarly, a seminal empirical study of pineapple production in Ghana by Conley and Udry (2010) shows that farmers adjust their inputs after observing the harvests of their neighbours who are using improved inputs. Our finding suggests that social learning is also important in the adoption of agricultural technology in Cambodia. Hence, promoting local sharing of knowledge on pest management can help increase compliance with the instructions for pesticide dose rates.

Household participation in social groups such as agricultural cooperatives or farmer groups has a positive relationship with the probability of complying with pesticide dose recommendations. That is, the probability of compliance is 19.8 percent higher if the farm household participates in a farmer group or agricultural cooperative, and it is statistically significant at the 1 percent level. This determinant represents farmers' social networking. This empirical finding supports the argument that social capital networking allows for the exchange of information among farmers when they participate in a rural institution or group (Teklewold, Kassie and Shiferaw 2013). This finding also implies that NGOs would have an important role in pesticide use practices, because most of the support for farmer organisations such as farmer groups and agricultural cooperatives comes from NGOs usually in the form of technical and financial assistance (Theng et al. 2014).

Vegetable landholding size has a positive and significant relationship with the probability of a farm household complying with recommended pesticide dose rates. For each additional hectare of land, the probability of compliance by farmers with recommended dose rates increases by 22 percent. The previous empirical study by Schreinemachers et al. (2017) found that vegetable plot size has an inverse linkage with the amount of pestcide used, which suggests that largeholders' pesticide use is more efficient than smallholders' pesticide use. In other words, our finding implies that the larger the cultivated area, the more attention farmers pay to the recommended pesticide dosage.

Finally, pesticide use practices also vary by province in our study area. Our results show that the average farm[3] uses around 1.4 kg less pesticide if a household is located in Battambang and 2.76 kg less if a household is in either Tboung Khmum or Kampong Cham. This finding can be reinforced by our descriptive statistics in the sense that most leafy vegetables such as mustard greens, bak choi , Chinese kale and while petoile, which are attractive to pests, are grown in Kandal province.

3 Kandal is the reference province.

6. Conclusion and policy implications

Farmers in Southeast Asia, including in Cambodia, rely heavily on chemical pesticides to protect their vegetable crops from pest damage. At the same time, the domestic contribution to total vegetable supply in Cambodia is low compared to the contribution of imported vegetables from Vietnam and Thailand. For this reason, improving the on-farm safety of domestic vegetable production would contribute significantly to promoting the demand for local vegetables, which is in line with the Cambodian government's strategy to diversify the agricultural sector. However, little is known about pesticide use practices in Cambodia's vegetable farming. In this paper, we have used cross-sectional survey data of 600 households, which was collected in late 2017 and early 2018 from four provinces which are the main domestic sources of many vegetable crops in Cambodia.

The descriptive statistics obtained from the household survey reveal that pests and diseases are the biggest challenge facing the smallholder vegetable farmers in our sample. Linked to this, our data also indicates that pesticides/herbicides account for the largest share in the input expenditure of vegetable farming in the study areas, suggesting that chemical pesticides are commonly used in vegetable farming in Cambodia. Additionally, farmers commonly mix different types of pesticides in a single spray which is not good practice.

In the empirical analysis, we investigated the factors that facilitate or impede pesticide use practices by applying ordinary least squares regression and probit model and clustering the standard error in the regression estimation at village level to ensure that it is robust for making inferences. There is empirical evidence that lower use of pesticides is associated with the age of farmers responsible for applying pesticides, educational attainment, female farmers, and household location in Battambang and Kampong Cham. At the same time, higher pesticide use has a significant linkage with farmers' misperceptions of pesticide use practices, and the proportion of pesticide spending to total input expenditure. Apart from this, knowledge/advice about pest management/control that farmers received from their peers and pesticide stores, household participation in social groups such as agricultural cooperatives, and farm size have positive relationships with the probability of farmer compliance with recommended pesticide doses.

These results imply that interventions aimed at reducing pesticide dependence through improving farmers' attitudes towards pesticide use and promoting women's participation in pest management remain current. Additionally, this study's empirical findings contribute to recent research on pesticide use in Cambodia's vegetable farming, by showing that farmers' educational level and geographical location are important entry points to lower pesticide use. Another important contribution of our study is that improving the dissemination of knowledge on pesticide use and promoting farmers' participation in social groups (e.g., agricultural cooperatives) would increase compliance with the recommended pesticide dose rates.

Finally, it should be noted that our study has some limitations that could be addressed in future research. First, we did not have information about environmental factors, such as rainfall patterns and soil conditions, that are likely to affect farmers' decisions to spray more or to use more hazardous pesticides. Second, this study used cross-sectional data, so the empirical results can suffer bias caused by unobserved time-invariant factors that could influence the dependent variables. This disadvantage could be minimised by using panel data, which would enable further studies to develop more accurate estimators.

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Annex 1: Types of pests and diseases affecting vegetables

Pest/disease	Mustard greens	Swatow mustard	Chinese mustard	Bok choi	White petiole	Cabbage	Chinese kale	Cauliflower	Bitter gourd	Cucumber	Yard-long bean	Eggplant	Lettuce	Peas	Total
Dangkov yol tong/rom	82	24	25	30	15	53	9	29	2	40	5	8	5	4	331
Teak Ku	19	1	11	22	7	1	6	1	0	2	0	1	2	0	73
Kra plerng /Sor/ Inflam	3	4	0	3	0	11	1	0	2	18	4	3	0	4	53
Round maggot	2	0	1	9	3	0	1	0	1	9	4	1	8	4	43
White fly/flea	1	0	1	0	0	4	0	4	3	16	5	8	0	1	43
Decay by fungi	2	0	5	7	1	4	0	7	4	3	4	0	3	0	40
Flea/ant	13	1	1	2	0	5	1	1	0	2	6	2	1	1	36
Blue/black/red/ white	2	0	3	4	7	2	1	0	1	7	3	0	0	0	30
Little pig warm	6	1	0	4	1	4	1	4	0	0	1	0	5	0	27
Me kbal roeung/ Me Khm	2	3	2	6	0	1	1	1	1	1	2	1	0	0	21
Stem maggot/ stem inju	2	1	1	0	0	7	0	0	1	4	2	1	1	0	20
Mo meach	0	0	1	0	2	0	0	0	8	3	4	1	0	0	19
Little ladybug	1	0	0	0	0	0	0	0	0	11	2	4	0	0	18
Dangkov snaeng si sle	2	0	1	2	1	2	0	2	1	1	1	0	0	0	13
Herd worm	0	0	0	0	0	0	0	1	0	2	3	1	0	4	11
Srang	1	0	0	0	0	0	0	2	5	1	2	0	0	0	11
Fruit maggot	0	0	0	0	0	0	0	0	0	1	6	1	0	2	10
Dhrip	0	0	0	0	0	0	0	0	0	5	0	3	0	0	8
Butterfly	1	0	1	1	3	0	0	0	0	0	0	0	0	0	6
Khnhong	1	0	0	0	0	0	0	2	0	0	2	0	0	0	5
Shrink leaves/ fruit	1	0	1	0	0	1	0	0	0	0	1	0	0	0	4
Inflame stem	0	0	0	0	0	2	0	0	1	0	0	0	1	0	4
Black flea	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
Flower loss	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
Small worm	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
Fruit fly	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rat	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Unknown	4	1	1	2	0	8	3	4	1	10	5	4	2	0	45
Total	145	36	55	92	40	105	24	58	31	139	64	41	28	21	879

Annex 2: List of pesticides from survey

#	Type	English name	Khmer name	Language	Active ingredients	Company	Target pests	Recommended dose per tank	Recommended dose per ha	Pre harvest interval (day)	Color label	WHO classification
1	Insecticide	N/A	ដង្កូវមរណៈ	Kh	Chlorantraniliprole 50g/l +Fipronil 50g/l	N/A	Stem borers, defoliators, fruit and pod borers, and leaf folders	Missing information	N/A	N/A	Yellow	II
2	Insecticide	Spiderman Plus	ស្ពាយឌឺមែនផ្លាស	Kh	No information	Cam AgroTop Co.,Ltd	Aphids	Missing information	N/A	N/A	Yellow	II
3	Insecticide	VIFONE	វីហ្វូន	Kh	Imidachlorprid 50%	Missing information	Aphids, bugs and mealy bugs	Missing information	N/A	N/A	Yellow	II
4	Insecticide	Chungsivlin	ឆុងស៊ីវលីន	Kh	Acetameprid 3000/kg + Burofezin 250/kg WP	Shienghai Agridever Co.,Ltd	Aphids, bug, mealy bugs, white fly	100 g mix with 300–400 L of water	N/A	15	Yellow	II
5	Insecticide	Samurai	សាមូរ៉ៃ	Kh	Lamda-cyhalothrin 10.6% +Thiamethoxam 14.1%	SPK 1	Thrips, hoppers, Red mites, Gold fly and Flea beetles	15–20 ml with 16 L of water	200–250 ml/ha	14	Yellow	II
6	Insecticide	N/A	ហេនឌើស៊ីស	Kh	Deltamethrin 2.5% W/VEC	Ruom Aphivad Kasekam	Leaf miner, fruit borers, hoppers, aphids, bugs and gold fly	30ml with 16L of water	2 tanks per 1000 m^2	14	Yellow	II
7	Insecticide	Best-One	បេសវ៉ាន	Kh	Monosultap 95% WP	Shienghai Agridever Co.,Ltd	Leaf folders, thrips, diamond back moth, stem borers, beetles	N/A	600–800 g with 300–400 L of water	14	Yellow	II
8	Insecticide	Hanangkor 40	ហេនអង្គរ 40	Kh	Emamectin Benzoate 4%W/V EC	Ruom Aphivad Kasekam	Diamond back moth, fruit borers, defoliators, army worms	15 ml mix with 16 L of water	N/A	7	Yellow	II
9	Insecticide	AK 47 2.0EC	អាកា ៤៧ 2.0EC	Kh	Emamectin Benzoate 2.0EC (w/w)	ក្រុមហ៊ុននីលីដា	Diamond Back worm	3–5.5 ml with 16 L of water	90–120 ml/1ha with 400–600L/ha	7	Yellow	II
10	Insecticide	Sapen Alpha	សាប៉ែន អាលផា	Kh	Alpha Cypermethrin 50g/L	Saigon Plant Protection Joint Stock	Stem borers, diamond back moth, green worm, flee beetle and mites	16–20 ml with 16 L of water	5 tanks for 1000 m^2	7	Yellow	II
11	Insecticide	No Insect	ដំណាំគ្មានដង្កូវ	Kh	OTP	Shienghai Agridever Co.,Ltd	Diamondback moth, core borers	20–30 ml with 25 L of water	600–800 ml with 300-400 L of water	7	Yellow	II
12	Insecticide	N/A	អូស៊ីន 20WP	Kh	Dinotefuran 200g/kg	Agrotechvita Co., Ltd	Flea beetles, Aphids, white fly	6.5 g with 16 L of water	2 tanks for 1000 m^2	3	Blue	III
13	Insecticide	M 40	អឹម 40	Kh	Emamectin Benzoate 14.8% Mathrine 0.2%	ក្រុមហ៊ុននីលីដា	Flea beetles, Diamond back moth, pod borers, mealy bugs, leaf minors, aphids and white flies	10 g with 25 L of water	N/A	N/A	Yellow	II
14	Insecticide	Mitigate 5%EC	មីធីហ្គេត	Kh	Fenpyroximate 5%	N/A	Aphids, white flies, red mites, fruit flies	35–40 ml with 18–20 L of water	N/A	7	Blue	III

15	Insecticide	M15	អឹមសី	Kh	Chlorfenapyr 100g/L Fipronil 50g/L	ក្រុមហ៊ុននីលីដា	Diamond Back worm, defoliators, leaf minors, aphids and white flies, green worm, red mites, grass hoppers.	15–25 ml with 25 L of water;	400–500 L/ha	7	Blue	III
16	Insecticide	Nurelle D25/2.5EC	នុយរ៉ែល	Kh	Chlorpyrifos 250g/l + Cypermethrin 25g/l	Dow AgrSciences LLC	Diamond back moth, green worms, fruit borers, thrips	40–50 ml with 16 L of water	N/A	7	Yellow	II
17	Insecticide	U-T 80	N/A	Kh	Chlorpyrifos 40%	សេះសមុទ្រ៣	Aphids and hoppers	Missing information	N/A	7	Yellow	II
18	Insecticide	Andotox 600EC	អានដូតុ 600 ជេ	Kh	Chlorpyrifos Ethyl 400g/l Cypermethrin 150g/l Imidacloprid 50g/l	Hoing An Cambo	Worms, hoppers, beetles	20–30 ml with 16 L of water	N/A	14	Yellow	II
19	Insecticide	ABSINA 3.6EC	អាប់ស៊ីណា	Kh	Abamectin 3.6% EC	N/A	Diamond back moth, green worms, fruit borers, thrips, flea beetles	20–30 ml with 16 L of water	2 tanks for 1000 m^2	14	Blue	III
20	Insecticide	FORMECTIN-XTRA 54EC	ហ្វ័រទីន ៥៤EC	Kh	Abamectin 5.4% EC	Forward (Cambodia) Ltd	Thrips, beetles, aphids, red mites	Mix 10 ml with 18 L of water for a 500 m^2 plot	150–200 ml/ha	14	Blue	III
21	Insecticide	K59 5.5EC	ក59 5.5EC	Kh	Abamectin 5.5%ww	ក្រុមហ៊ុននីលីដា	Diamond back worm on cabbage and fruit borers on beans	Mix 3–5.5ml with 16L of water	90 –120 ml/ha, spray 400–600 L/ha	7	Blue	III
22	Insecticide	Mospilan	ម៉ូសពីឡាន	Kh	Acetamiprid 3% w/w	Agrochem Joint Stock Company	thrips, bugs, aphids, mealy bugs	10–20 ml with 10 L of water	0.5–1 L/ha	7	Yellow	II
23	Insecticide	Reasgant 1.8 EC	N/A	VN	Abamectin 18g/l	N/A	information is in Vietnamese	5–8 ml with 10 L of water	5–6 tanks for 1000 m^2	7	Yellow	II
24	Insecticide	Prevathon 5SC	ព្រីវ៉ាថន ៥SC	Kh	5-bromo-2-2-H-pyrazole-3-carboxilic acid-amide 5.17% W/V SC	Du Pont	Diamond Back worm	2 packs (15 ml per pack) per spraying tank (16 L);	600 ml/ha; 20 tanks per ha	N/A	Blue	III
26	Insecticide	Warrior	កំចាត់ដង្កូវ	Kh	Spirodiclocfen Emamectin Benzoate	N/A	Stem borer, butterfly, leaf borer, all type of aphids, fruit borer, diamondback worm	30–40 ml with 25 L of water	10–20 tank (25 L/tank) per hectare	N/A	Yellow	II
28	Insecticide	Kon Neak 2	កូននាគ ២	Kh	Imidachlorprid 70% WDG	Angkor Green Company	caterpillar, white fly, sucks related insect, aphids, and brownplant hopper	5–10 ml with 25 L of water for $800m^2$	N/A	7	Blue	III
29	Insecticide	Kon Neak 6	កូននាគ ៦	Kh	Pymetrozine + Thiamethoxam 35%WDG	Angkor Green Company	Worms, leaf miner, Flea beetle, bugs, Brown planthopper, Blue hopper, white fly, aphids, thrips, caterpillars	2–5 g with 25 L of water for 1000 m^2	N/A	7	Blue	III

30	Insecticide	Tun-Fy	ទូនហ្វី	Kh	Nitenpyram 5%w/w	Greenland & Pesticide	hoppers and flea beetles	20 g with 18 L of water	N/A	10	Blue	III
31	Insecticide	King Dragon 7	ស្តេចនាគ៧	Kh	Baccillus Thoringiensis Var Kustaki 3a, 3b o.5%WP	Angkor Green Company	Diamondback worm, leaf folder, defoliator	20–30 g with 16 L of water for 500 m^2	N/A	N/A	Blue	III
33	Insecticide	(All in thai language)	N/A	Thai	N/A	N/A	N/A	20–30 ml with 20 L of water	N/A	N/A	Blue	III
34	Insecticide	N/A	គោកម្លាត់សត្វល្អិត 42	Kh	Emmamectin Benzoate 4% W/V EC	Angkor Green Company	Leaf folders, defoliators, stem borers, fruit borer, leaf miner, army worm, common worms and hoppers	10 ml with 16 L of water, 2 tanks (16L) for $1000m^2$	N/A	7	Blue	III
35	Insecticide	Visher 25EC	វីសើរ	Kh	Cypermethrin 25% w/w	ក្រុមហ៊ុនភាគហ៊ុនថ្នាំសម្លាប់សត្វល្អិតវៀតណាម	Rice leaf cutter, and fruit borers on mango	15–20 ml with 16L of water	N/A	14	Yellow	II
36	Insecticide	Paolo550	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
37	Insecticide	Perin	ពើរីន	Kh	Permethrin	N/A	N/A	500 g/L	N/A	N/A	Yellow	II
38	Insecticide	Abamectin	N/A	Kh	Avermectin, Abamectin	Cambodian Science Crops	Leaf miner, leaf folders, flower and fruit borer	10–20 ml mix with 16 L of water	N/A	N/A	Yellow	II
40	Insecticide	IndoGold	អិនដូហ្គោល	Kh	N/A	Cambodian Science Crops	N/A	N/A	N/A	N/A	Yellow	II
44	Insecticide	ATYLO 650WP	N/A	VN	Acetamiprid 400g/Kg and Buprofezin 250 g/kg	Hebei Dahu Bio-Chemical Co., Ltd	brown planthopper	4–6 g/L	300 g/ha 400–600 L/ha	15	Yellow	II
46	Insecticide	SAMURAI	អ្នកជំនាញកំចាត់សត្វល្អិត	Kh	Lamda-cyhalothrin 10.6% + Thiamethoxam 14.1%	SING	thrips, red spider, gold fly, flea beetle	15–20 ml with 16L of water	200–250 ml/ha	N/A	Yellow	II
47	Insecticide	CRT Athireach Super	CRT អធិរាជស៊ុបពើ	Kh	Emamectin Benzoate 6% , Matrine 1%,	N/A	flower and fruit borer, thrips, leaf miner, leaf borer, mites	20–40 ml with 20 L of water	N/A	N/A	Yellow	II
49	Insecticide	N/A	អាស៊ីន	Kh	Acetamiprid 150 g/kg and Buprofezin 150 g/kg	Cambodian Science Crops	mites, white flies, thrips,	20–30 g with 25 L of water	N/A	14	Yellow	II
50	Insecticide	B-41	បេ-៤១	Kh	Thiamethoxam 250g/kg, Acetamiprid 100 g/kg and Special inactive element 650g/kg	ក្រុមហ៊ុននីលីដា	thrips, aphids, blue hoppers, flea beetle, fruit borers	9 g with 25 L of water	N/A	7	Blue	III
57	Insecticide	Sinaprop 70W ZINC++	ស៊ីណាប្រប	Kh	Propineb 70WB	Sinamyang Group	fungus-related diseases, young leaf wilt	115 to 155 g	N/A	14	Green	IV
58	Insecticide	Biller 20% SP	ប៊ីឡឺ	Kh	Acetamiprid 200g/kg	Green Khmer International Limited	aphids, thrips, sugarcane borer, white fly	2–4 g with 12–16 L of water	N/A	N/A	Yellow	II
62	Insecticide	Mansion	មេនស៊ិន	Kh	Chlorothalonil 75% WP	Contact group (Cambodia) Co., Ltd	mealy bugs	20–30 g	N/A	7–10	Blue	III

63	Insecticide	Common worms	ដង្កូវទូទៅ	Kh	Emamectin Benzoate 4%, Permethrin 50% and Solvent 46%	U T crop protection company (យូ ធី ក្រុបប្រូថេកសិន)	fruit borer, leaf cutter, lavae of leaf borer, aphids, army worm, leaf miner, thrip, diamond back, stem borer,	20 ml with 20 L of water, and 40 ml with 20 L of water in severed damage,	N/A	7	Yellow	II
66	Insecticide	KanKun 110SC	N/A		Chlorantraniliprole 110 g/l	N/A	N/A	300–500 ml with 1000 L of water	N/A	10	Green	IV
67	Insecticide	Xentari	N/A		Bacillus thuringiensis subsp. Aizawai Lepidopteran Active toxin 10.3% and Inert ingredients 89.7%	Valent Biosciences	army worms, looper, webworms, cutworms	N/A	N/A	N/A	Blue	III
68	Insecticide	Bia	ប៊ីអេ	Kh	N/A	N/A	fungus-related diseases, fruit wilt	12 ml with 16 L of water	N/A	N/A	Blue	III
69	Insecticide	N/A	N/A		Chlorpyrifos and cypermethrin	4P	common worms	50 g with 300 ml of water	N/A	N/A	Blue	III
71	Insecticide	No Insect	ដំណាំគ្មានដង្កូវ	Kh	OTP	Shienghai Agridever Co.,Ltd	Diamondback moth, core borers	20–30 ml with 25 L of water	600–800ml with 300–400L of water	7	Yellow	II
73	Insecticide	Insect Medai	ដង្កូវមេដៃ	Kh	N/A	Shienghai Agridever Co.,Ltd	common worms	N/A	N/A	N/A	Yellow	II
74	Insecticide	Formectin-Xtra 54EC	យូ អែហ្វ ស៊ី	Kh	Abamectin 5.4% EC	Forward Cambodia Agro Chemical	hoppers, aphids, bugs, thrips, flea beetle, common worm, red mite	10 ml with 18 L of water	150–250 ml/ha	14	Yellow	II
76	Insecticide	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
77	Insecticide	Actara 25WG	អាកតារា 25WG	Kh	Thlamethoxam 250 g/kg and dissolve and other elements 750 g/kg	ស៊ីនហ្គេនតា វៀតណាម	bugs species, brown planthopper	N/A	25–30 g mixed with 500–600 L of water	7	Green	IV
78	Insecticide	Pre Lo	ព្រីឡូ	Kh	Emamectin Benzoate 4% and Permethrin 50% EC	ក្លាន់ក្រហម	stem borer, leaf folder, diamond back, backbone worm, all types of aphids	30–40 ml with 25 L of water	10–20 tank (25 L/tank) per hectare	7	Yellow	II
79	Insecticide	Mekomectin 70WG	N/A	VN	Emamectin benzoate 70g/kg	Vietnamese company	common worms	4.8–6 g with 16 L of water	400–500 L/ha	7	Yellow	II
80	Insecticide	Sadam 40	N/A		Emamectin benzoate 4%EC	N/A	Blue worms, breakbone worms, flower and fruit borers, red mite, caterpillar, flea beetle, army worms, leaf miner	15–25 ml with 25 L of water	400–500 L/ha	7	Yellow	II
81	Insecticide	Methomyl	N/A	Thai	Information in Thai	N/A	N/A	N/A	N/A	N/A	Red	I
82	Insecticide	Superman	កំពូលបុរស កំចាត់ដង្កូវ	Kh	Chlorantraniliprole 45 g/l and Fipronil 54g/l	Pesticide SAMAKI Co.,Ltd	Diamond back worm, fruit borers	20 ml with 16 L of water	0.4–0.6 L/ha	7	Yellow	II

83	Insecticide	Golden Dragon	ហ្គោលដិន ដ្រាហ្គន	Kh	Ehtyl 530 g/L , Cypermethrin 55 g/L and other elements	Saigon Plant Protection Joint Stock	all types of worms	N/A	N/A	14	Yellow	II
84	Insecticide	Ematin 60EC	N/A	VN	Emamectin benzzoate 60 g/l	Shanghai Agricultural Chemicals Co.,Ltd	bugs	Information in Vietnamese	N/A	N/A	Yellow	II
85	Insecticide	Define 500SC	N/A		Diafenthiuron 500g/l	Sundat Crop Science Co., ltd	common worms	15_30 ml with 16 L of water	500 L/ha	7	Green	IV
86	Insecticide	N/A	គោព្រែកម្ចាត់ មមាច	Kh	Buprofezin 60% + Nitenpyram 10% WDG	កម្ពុជាកសិ	aphids, flea beetles, ladybugs, thrips and white fly	mix 25g with 25 L of water	N/A	7	Yellow	II
87	Insecticide	ANMAN 400EC	អានម៉ាន់ ៤00EC	Kh	Chlorpyrifos Ethyl 350g/l Fipronil 50g/l	ភាគហ៊ុន និហរ័ណ អាហរ័ណ ថ្នាំ ជីកសិកម្ម ហ៊ងអិន វៀតណាម	rice leaf folder and bean fruit borers, beetles, aphids, Diamondback worm	16–20ml with 8 L of water	0.8–1 L per ha	N/A	Yellow	II
88	Insecticide	K59 5.5EC	កា59 5.5EC	Kh	Abamectin 5.5%ww	ក្រុមហ៊ុននីលីដា	Diamondback worm on cabbage and fruit borers on beans	90–120ml/ha Mix 3–5.5ml with 16 L of water	spray 400–600 L/ha	7	Blue	III
89	Insecticide	Samlab 5EC	កំពូលដង្កូវ	Kh	Emamectin Benzoate 5% EC	កម្ពុជាកសិ	flea beetles, Diamond Back worm, army worm, defoliators, leaf minor, aphids	mix 15–25 ml with 25 L of water	N/A	7	Yellow	II
90	Insecticide	N/A	គោព្រែកម្ចាត់ សត្វល្អិត	Kh	Acetamiprid 3% + Abametin 1% EC	កម្ពុជាកសិ	leaf folder, fruit borer, green hoppers, red spiders, grasshoppers, crickets, thrips, aphids	mix 40–50 ml with 25 L of water	N/A	7	Yellow	II
91	Insecticide	Prevathon 5SC	ព្រីវ៉ាថន ៥SC	Kh	5-bromo-2-2-H-pyrazole-3-carboxilic acid-amide 5.17% W/V SC	Du Pont	Diamond Back worm	600ml/ha; 2 packs (15 ml per pack) per	spraying tank (16L); 20 tanks per ha	N/A	Blue	III
92	Insecticide	M15	អឹមសី	Kh	Chlorfenapyr 100g/L Fipronil 50g/L	ក្រុមហ៊ុននីលីដា	Diamond Back worm, defoliators, leaf minors, aphids and white flies, green worm, red mites, grasshoppers.	15–25ml with 25 L of water;	400–500L/ha	7	Blue	III
93	Insecticide	AK 47 2.0EC	អាកា ៤៧ 2.0EC	Kh	Emamectin Benzoate 2.0EC (w/w)	ក្រុមហ៊ុននីលីដា	Diamondback worm	90–120 ml/1ha; mix 3–5.5ml with 16 L of water;	spray 400–600L/ha	7	Yellow	II
94	Insecticide	ANMANTOX 3.8EC	អាន់ម៉ាន់តុ ៣.៨ EC	Kh	Emamectin Benzoate 38g/l	ភាគហ៊ុន និហរ័ណ អាហរ័ណ ថ្នាំ ជីកសិកម្ម ហ៊ងអិន វៀតណាម	bean pod borers	N/A	N/A	N/A	Yellow	II
95	Insecticide	Do ABIN 3.8EC	N/A	VN	Emamectin Benzoate 38%w/w	Tainjin Renong Pesticide Industry Co., Ltd	N/A (information is in Vietnamese)	2–3ml with 16L of water;	spray 400L/ha	7	Yellow	II
96	Insecticide	Mekomectin 3.8EC	N/A	VN	Emamectin Benzoate 38g/l	N/A (The information is in Vietnamese)	N/A (information is in Vietnamese)	mix 4–6ml with 16L of water;	spray 400-600L/ha	7	Blue	III
97	Insecticide	Mapy 48EC	N/A	VN	Chlorpyrifos Ethyl 480g/l	N/A (The information is in Vietnamese)	N/A (information is in Vietnamese)	N/A (information is in Vietnamese)	N/A	14	Yellow	II

99	Insecticide	CYPERTIN 100EC	ស៊ីបភើទីន 100 EC	Kh	Cypermethrin 10%EC	ស៊ីណាមីយ៉ាង (ខេមបូឌា)	hoppers, thrips, aphids, leaf folders, stem borers, leaf cutters, fruit borers, leaf minors, flea beetles, red mites…	mix 25–40ml with 25L of water;	dosage 300–500ml/ha	14	Yellow	II
100	Insecticide	Permicide	N/A		Permethrin 500g/l	N/A	N/A (information is in Vietnamese)	mix 15–20ml with 16L of water; or 200–250 ml with 200 L of water	N/A	N/A	Yellow	II
101	Insecticide	Seekker 10	N/A	Thai	CyanO-3-phenoxybenzyl-33-2.2-dimenthylcyclopropane carboxylate 10% W/V EC	N/A (The information is in Thai)	N/A (information is in Thai)	N/A (information is in Thai)	N/A	N/A	Blue	III
104	Insecticide	FORMETHOXAM 250 WDG	កុងហ្វ៊ូ	Kh	Thiamethoxam 25%WDG	Forward (Cambodia) Ltd	thrips, beetles, aphids	30g mix with 200L of water	N/A	14	Blue	III
105	Insecticide	FORMECTIN-XTRA 54EC	ហ្វ៉ូទីន ៥៤EC	Kh	Abamectin 5.4% EC	Forward (Cambodia) Ltd	thrips, beetles, aphids, red mites	150–200ml/ha; mix 10ml with 18L of water for a 500m² plot	N/A	14	Blue	III
106	Insecticide	FOOTSURE 55EC	N/A	Kh	Abamectin 30g/l Emamectin Bezoat 35g/l	ក្រុមហ៊ុនពាណិជ្ជកម្ម នុង យៀង	Diamond back worm, army worms and green worms	mix 5–7 ml with 16 L of water	N/A	7	Yellow	II
107	Insecticide	Scorpion 88SC	N/A	Kh	Chlorantraniliprole 45g/l Abamectin 43g/l	Pesticide SAMAKI Co.,Ltd	leaf folders, stem borers, fruit borers	0.5 L/ ha; mix 25 ml with 16 L of water; spray 2 tanks for 1000 m²	N/A	7	Yellow	II
108	Insecticide	Reasgant 3.6EC	N/A	VN	Abamectin 36g/l	N/A (The information is in Vietnamese)	N/A (information is in Vietnamese)	N/A	pesticide dose: 0.15–0.25 ml/ha app. dose: 400–600 l/ha	N/A	Yellow	II
109	Insecticide	Earthcron	N/A	Thai	0-4 Bromo-2-chlorophenyle..	N/A (information is in Thai)	N/A (information is in Thai)	N/A (information is in Thai)	N/A	N/A	Yellow	II
111	Insecticide	Chlorferan 240SC	N/A	VN	Chlorfenapyr 240 g/l and other 760 g/l	Vietnamese company	stem borers, bugs	15 ml with 16 L of water	400–500 L per ha	7	Yellow	II
112	Insecticide	Mekomectin 3.8EC	N/A	VN	Emamectin Benzoate 38 g/l	Vietnamese company	stem borers, bugs, aphids	4–6 ml with 16 L of water	100–150 ml per ha	7	Blue	III
113	Insecticide	Nongiahung 75WP	N/A		Cyromazine 75% W/W and other elements 25%	T.P.C Cambodia	leaf miner, butterfly worm, leaf borer	10–12 g with 16 L of water	200–250 g/ ha	7 - 14	Green	IV
115	Insecticide	ViCarben 50SC	N/A	VN	Carbendazim 500 g/l and other elements 1 L	VIPESCO	N/A (information is in Vietnamese)	N/A	N/A	N/A	Green	IV
116	Insecticide	Supercook 85WP	N/A	VN	Copper Oxychloride 85% WW	AHP (Vietnamese language)	N/A (Vietnamese language)	75–110 g with 20 L of water	1.5 kg to 2.2 g/a with 400L of water	7 - 14	Blue	III

117	Insecticide	Frog 44EC	N/A		N/A	N/A	leaf folders, leaf miners, white fly, mites, fruit borer	Cannot read due to poor quality of image	0.5 L/ha with 320 to 400 L/ha	7	Yellow	II
119	Insecticide	TOTO	តូតូ	Kh	Chiorpyrifos 42% and cypermethrin	សេះសមុទ្រ ៣	Diamondback worm, stem borer, leaf folder, leaf miner, Brown planthopper, white aphids, army worm	40–50 ml with 25 L of water	10–20 tanks per ha	7	Yellow	II
120	Insecticide	Saga	N/A	China	48 g/L Emamectin Benzoate	Sunking Chemical Industrial Co., Ltd	stem borer, leaf miner	1.5–2.5 ml	N/A	N/A	Green	IV
123	Insecticide	Atonik 1.8SL	N/A		Sodium-5-Nitroguaiacolate, Sodium-O-Nitrophenolate and Sodium-P-Nitrophenolate	Asahi chemical MFG Co., Ltd. Japan	N/A (no information)	N/A	N/A	N/A	Yellow	II
124	Insecticide	Sun Fen 500SC	N/A		diafenthiuron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
126	Insecticide	N/A	ដង្កូវអស់រិទ្ធិ	Kh	N/A	ក្រុមហ៊ុន យូ ធី ក្រុបប្រូធិកសិន	Diamondback worm, army worm, leaf miner, stem borer, fruit and flower borer, all types of aphids	20–40 ml with 20 L of water	10–20 tanks per ha	7	Yellow	II
127	Insecticide	Padan 95SP	N/A		N/A	Sumitomo Chemical Co., Ltd	information in Vietnamese	20–28 g with 16 L of water	0.5–0.7 kg/ha	7	Yellow	II
128	Insecticide	Busin 25WP	ប៊ូស៊ីន	Kh	Buprofezin 25%WP	Sinamyang group	hoppers, bugs, thrips and sap suckers species	40–55 g with 25 L of water	0.5–0.7 kg with 40 L of water	14	Green	IV
129	Insecticide	Radiant 60SC	N/A	VN	Spinetoram 60 g/L and other elements 1L	Dow AgroSciences	information in Vietnamese	15 ml with 16 L of water or 15 ml with 30 L of water (depending on level of damage	320 L per ha	N/A	Green	IV
130	Insecticide	Superman 99SC	កំពូលបុរស	Kh	Chlorantraniliprole 45g/L and Fipronil 54g/L	Pesticide SAMAKI Co., Ltd	leaf miner, stem borer, fruit borer, fly worm	25 ml with 16 L of water	0.5 L/ha with 320 to 400 L/ha	7	Yellow	II
131	Insecticide	Boxer 50EC	ប៊ុកសើ	Kh	Profenofos 50% and inactive elements 50%	ជំរឹខ្មែរ	stem borer, leaf miner, rat, fruit borer, fly worm	20–30 ml with 16 L of water	400–600 ml with 350–500 L/ha	7	Yellow	II
132	Insecticide	Cylux 500EC	ថ្នាំកំចាត់ដង្កូវ	Kh	Trichlorfon 485 g/L Fipronil 15g/L	N/A	common worms	40 ml with 16 L of water	320–400 L/ha	N/A	Yellow	II
133	Insecticide	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
134	Insecticide	ATYLO 650WP	N/A	VN	Acetamiprid 400g/Kg and Buprofezin 250 g/kg	Hebei Dahu Bio-Chemical Co., Ltd	brown planthopper, aphids	4–6 g/L	300 g/ha 400–600 L/ha	15	Yellow	II

135	Insecticide	N/A	កុំព្រួយ	Kh	Unreadable	កម្ពុជាកសិ	N/A	25–30 ml with 25 L of water	320–400 L/ha	7	Yellow	II
136	Insecticide	Cylux 500EC	កំពូលដង្កូវ	Kh	Fipronil 15 g/L and another one(could not understand)	Golden rice agrochemicals company limited	common worms	400 ml with 16 L of water	320–400 L/ha	N/A	Yellow	II
137	Insecticide	Aben 168EC	N/A	VN	Pyridaben 150 g/l, Abamectin 18 g/l and other inactive elemtn 832 g/l	Vietnamese company	N/A	8–12 ml with 16 L of water	400–600 L/ha	7	Yellow	II
138	Insecticide	Best one	បេស វ៉ន	Kh	Monosultap 95% WP	Shienghai Agridever Co.,Ltd	leaf miner, diamondback worm, stem borer, thrips	50 g with 2 L of water	12–15 pack per ha	N/A	Yellow	II
139	Insecticide	Vitashield Gold 600EC	N/A	VN	Alpha-cypermethrin 50g/l, Chlorpyrifos Ethyl 545g/l and Indoxacarb 5g/l	Thanhson	information in Vietnamese	N/A	0.6–0.8 L with 400 L of water per ha	14	Yellow	II
140	Insecticide	Kon Neak 6	កូននាគ ៦	Kh	Pymetrozine+ Thiamethoxam 35%WDG	Angkor Green Company	worms, leaf miner, flea beetle, bugs, brown planthopper, blue hopper, white fly, aphids, thrips, caterpillars	2–5 g with 25 L of water for 1000 m^2	N/A	7	Blue	III
141	Insecticide	Selecron 500EC	សេលេក្រុន ៥០០EC	Kh	Profenofos Q500 g/l and other and solubale element 500 g/l	Syngenta Vietnam Ltd	N/A	N/A	N/A	N/A	N/A	N/A
144	Insecticide	OSHIN	អូស៊ីន	Kh	Dinotefuran 200g/kg	Agrotechvita Co., Ltd	flea beetle, bugs, aphids, brown planthopper, blue hopper, fruit fly	1 pack (6.5 g) with 16 L of water	N/A	1-3	Blue	III
145	Insecticide	Able Sara	អាប៊ី សារា	Kh	Thiamethoxam 350 g/kg	Marbo Agricultural International Investment Co., Ltd	leaf miner, bugs, dimondback worm, mites	2 g with 16 L of water, spray 500 m^2	N/A	N/A	Yellow	II
147	Insecticide	N/A	ប៊ិលត៍ WG24	Kh	Flubendiamide 240 g/kg and additional elements 760 g/kg	Bayer Cambodia Co.,Ltd	N/A	N/A	N/A	3	Blue	III
148	Insecticide	No Insect	ដំណាំគ្មានដង្កូវ	Kh	OTP	Shienghai Agridever Co.,Ltd	Diamondback moth, core borers	20–30 ml with 25 L of water	600–800 ml with 300–400 L of water	7	Yellow	II
149	Insecticide	Nitrowin	N/A	VN	Information in Vietnamese	N/A	N/A	10–16 ml with 16 L of water	N/A	7	Blue	III
150	Insecticide	Super Klang 50EC	N/A		Emamectin Benzoate	N/A	leaf folder, stem borer, fruit borer, red mites, aphids, thrips, hopper, white mites	5–7 ml with 16 L of water	N/A	7	Yellow	II
151	Insecticide	Appasa 600EC	អាផាសា	Kh	Chlorpyrifos 250 g/L, Fenobucard 350 g/L and other inactive elements 400 g/L	N/A	common worms, bugs	15–20 ml with 16 L of water	400–500 L per ha	7	Yellow	II

152	Insecticide	Anmantox 3.8EC	អានម៉ាន់តុ ៣.៨ EC	Kh	Emamectin Benzoate 38 g/L	ក្រុមហ៊ុន ភាគហ៊ុន និហារ៉ែណ អាហ៉ារណ ថ្នាំ ជីកសិកម្ម ហ៊ាង អ៊ិន	stem and fruit borer, red mite, all types of aphids, beetles	3–5 ml with 16 L of water	N/A	14	Yellow	II
154	Insecticide	Match 0.50EC	N/A		N/A	Syngenta Indonesia	N/A	N/A	N/A	N/A	N/A	N/A
156	Insecticide	Abelmecteen	ម៉ាម៉េចទីន ៣៨EC	Kh	Emamectin Benzoate 38 g/L and other inactive elements 62 g/L	Marbo Agricultural International Investment Co., Ltd	leaf miner, stem borer, fruit borer, fly worms, bugs	N/A	N/A	N/A	Yellow	II
158	Insecticide	Sec Saigon EC	N/A		Cypermethrin 500 g/L and other inactive elements	SPC	N/A	4–8 ml with 16 L of water	0.1–0.2 L/ha	14	Yellow	II
159	Insecticide	Chess 50WG	N/A	VN	Pymetrozing 500 g/kg and additive 500 g/kg	Syngenta Vietnam Ltd	information in Vietnamese	120–200 g with 16–25 L of water	400–500 L/ha	7	Blue	III
160	Insecticide	N/A	ដង្កូវអស់លក្ខណ	Kh	Emamectin Benzoate 5.5% WDG and Solvent 94.5%	ក្រុមហ៊ុនយូ ធី ក្រុបប្រូតិចសិន	Diamondback, leaf folder, stem borer, blue worm, red mite, caterpillar, grasshopper, aphids, bugs, white fly,	10 g with 25 L of water	10–20 tanks per ha	7	Yellow	II
163	Insecticide	Morpride 20WP	N/A		Acetamiprid 20% W/W	HP	N/A	12–16 g with 16 L of water	500–600 L/ha	7	Yellow	II
165	Insecticide	Tatimec 3.6EC	N/A	Kh	Abamectin 36 g/L	ក្រុមហ៊ុនយូ ធី ក្រុបប្រូតិចសិន	stem borer, red mite	5–10 ml with 16 L of water	150–250 L/ha	7	Blue	III
166	Insecticide	Regent Energy	N/A	VN	Fipronil 50 g and other element 950 g/L	Bayer Cambodia Co.,Ltd	information in Vietnamese	20–30 ml with 16 L of water	N/A	N/A	Yellow	II
167	Insecticide	Formectin-Xtra 54EC	យូ អែហ្វ ស៊ី	Kh	Abamectin 5.4% EC	(missing)	hoppers, aphids, bugs, thrips, flea beetle, common worm, red mite	10 ml with 18 L of water	150–250 ml/ha	N/A	Yellow	II
168	Insecticide	N/A	N/A	VN	Cyromazine 75% w/w	Nanjing Suyan Kechuang Agrochemical Co., ltd	information in Vietnamese	12 g with 16 L of water	400 L/ha	7	Green	IV
169	Insecticide	Saizole 5SC	សាយហ្សុល	Kh	Hexaconazole 50 g/L	ក្រុមហ៊ុន សាយហ្គនផ្លេន ប្រូថេកសិន យ៉ាញស្តុក (Vietnam)	leaf spot, root wilt, fungus related, white mite	30–50 ml with 16 L of water	0.5–1 L/ha	7	Blue	III
170	Insecticide	Tikemectin 4.0EC	N/A	VN	Emamectin benzoate 40g/L	Vietnamese company	information in Vietnamese	N/A	75–100 ml/ha	N/A	Blue	III
172	Insecticide	Lost due to tearing	N/A	Kh	Cypermethrin 250 g/L	ក្រុមហ៊ុន កសិវិសិដ្ឋ គ្រុប	leaf-cutting worm, leaf folder, army worm, blue worm, fruit borer, young-leaf borer	10–20 ml with 16 L of water	200–400 ml/ ha	14	Yellow	II
173	Insecticide	RidomilGold 68WG	N/A	VN	Metalaxyl M 40g/kg, Mancozeb 640 g/kg	Syngenta Vietnam Ltd	information in Vietnamese	80–120 g with 25 L of water	3 kg per ha	7	Green	IV

174	Insecticide	N/A	N/A		Chlorpyrifos Ethyl 55%, Cypermethrin 5% and other element 40%	Unreadable	N/A	N/A	N/A	N/A	N/A	N/A
175	Insecticide	Tungmectin 5.0EC	N/A		Emamectin Benzoate 5% and other elements 95%	N/A	N/A	2–4 ml with 16 L of water	400–600 L/ha	N/A	Yellow	II
178	Insecticide	Parida 15EC	ប៉ារីដា ១៥ EC	Kh	N/A	Papaya Company	thrips, mites, bugs, brown planthopper, hoppers and aphids	25–30 ml with 16 L of water	N/A	N/A	Green	IV
179	Insecticide	Blockan	N/A	VN	Flutriafol 250 g/L and other elements 1L	Vietnamese company	information in Vietnamese	40 ml with 25 L of water	400 L per ha	7	Green	IV
181	Insecticide	SAT	N/A	VN	Cytosinpeptidemycin 4% and other 96%	NAMBACK Company	information in Vietnamese	25 ml with 25 L of water	500–800 L/ha	N/A	Green	IV
182	Insecticide	Golden Dragon	ហ្គោលដិន ដ្រាហ្គន	Kh	Ehtyl 530 g/L , Cypermethrin 55 g/L and other elements	Saigon Plant Protection Joint Stock	leaf folder, stem borer, leaf miner, diamondback, bugs	15 ml with 16 L of water	N/A	14	Yellow	II
184	Insecticide	Mekomectin 70WG	N/A		Emamectin benzoate 70g/kg	N/A	information in Vietnamese	4.8–6 g with 16 L of water	400–500 L/ha	7	Blue	III
186	Insecticide	Vfone 50EC	វីហ្វូន ៥0EC	Kh	N/A	ក្រុមហ៊ុន កសិវិសិដ្ឋ គ្រុប	brown planthopper, bugs, black mites	20–30 ml with 20 L of water	400–600 ml with 320–400 L of water	7-14	Yellow	II
187	Insecticide	Billaden 50EC	N/A		Emamectin Benzoate 50g/L	N/A	red mites, blue worms, army worms, thrips	N/A	N/A	N/A	Blue	III
190	Insecticide	Anboom 40EC	អានប៊ុម ៤0EC	Kh	Chlorpyrifos ethyl 40% and common substances 60%	N/A	brown planthopper, aphid species, army worm	25 ml with 8 L of water	1 L/ha	7	Yellow	II
191	Insecticide	Tiper Alpha 5EC	N/A		Alpha Cypermethrin 5% w/v and other elements 95%	Agrotech Import Export Company	stem borer, bugs, fruit borer, thrips, leaf cutter, aphids	6–12 ml with 8 L of water. 4–5 tank/ 1000 m^2	0.3–0.6 L/ha	14	Yellow	II
192	Insecticide	Axe 240SC	ពូថៅ	Kh	Unreadable	SAKARA	common worm resistant to other pesticides	20 ml with 25 L of water	400–500 L/ha	N/A	Yellow	II
193	Insecticide	Chlorteran 240SC	N/A	VN	Chlorferanpyr 24 g/L and other elements 760 g/L	NG CYEN Biochemistry	information in Vietnamese	15 ml with 16 L of water	400–500 L/ha	7	Yellow	II
194	Insecticide	Rholam Super 50SG	N/A		Emamectin Benzoate 48 g/kg, Matrine 2 g/ kg and other element 950 g/kg	Beijing Agron Biology Medicine Co., Ltd	worms	5 g with 16 L of water	400–600 L/ha	7	Blue	III
196	Insecticide	N/A	ខុនហ្វីដរ ២00SL	Kh	Unreadable	Bayer Cambodia Co.,Ltd	missing information	N/A	N/A	N/A	Blue	III
200	Insecticide	Emart 50WDG	អីម៉ាត ៥0WDG	Kh	Emamectin 50g/kg	Cambodian Science Crops	leaf folder, silver mite, blue worm, diamondback, white fly, red mite	10 g with 16–25 L of water	100–200 g/ha	14	Yellow	II
202	Insecticide	VBT usa wp 16000 IU/mg	N/A	VN	Bacillus thuringiensis	Viet Trong	common worms	20 g with 16 L of water	0.5–1.2 kg with 400 L of water	7	Green	IV

203	Insecticide	ViCIDI-M 50EC	N/A	VN	Phwnrhorw 48% w/w and Etofenprox 2%	Jingma Chemicals Co., Ltd	information in Vietnamese	30–40 ml with 8L of water	1.6–2 L with 400–600 L/ha	7	Yellow	II
206	Insecticide	Good 150SC	N/A	VN	Flufiprole 50 g/L and Indoxacarb 100 g/L	Vietnamese company	information in Vietnamese	15 ml with 25 L of water	400–500 L/ha	7	Blue	III
208	Insecticide	Bokatoh 700WG	ល្បុកកាតោ	Kh	Pymetronzine 500 g/kg and Acetamiprid 200 g/kg	Pesticide SAMAKI Co.,Ltd	brown planthopper, white fly, aphids, thrips,	20 g with 16 L of water and two tank (16 L*2) for 1000 m^2	320–400 L/ha	N/A	Yellow	II
209	Insecticide	Actara 25WG	N/A	VN	Thiamethoxam 250 g/kh and other element 750 g/kg	Syngenta Vietnam Ltd	information in Vietnamese	N/A	25–30 g/ ha or 500–600 L/ha	7	Green	IV
210	Insecticide	Sraka Neak	ស្រកានាគ	Kh	Acetamiprid, Lambda-cyhalothrin 225 g/kg WP	Angkor Green Company	flea beetle, white fly, aphids, caterpillars and worms	25 g with 25 L of water	N/A	7	Yellow	II
212	Insecticide	Xarid 300SC	N/A	VN	Indoxacarb 150g/L , Imidacloprid 150g/L	Vietnamese company	Diamondback worm, mealy bugs	5–10 ml with 25–30 L of water	N/A	14	Yellow	II
213	Insecticide	Panil 800 WG	ប៉ានីល 800WG	Kh	Fipronil 800g/kg	Papaya Trading co,. Ltd (Cambodia)	worms, hoppers, beetles	5 g with 32 L of water	N/A	14	Yellow	II
214	Insecticide	RHINO 555 50EC	រីណូ555 50EC	Kh	Imidachlorprid 50g/l	Papaya Trading co,. Ltd (Cambodia)	bugs, hoppers	7–10 ml with 8 L of water	N/A	7–10 days	Yellow	II
215	Insecticide	RHINO 007 40EC	រីណូ 007 40EC	Kh	O,S-Dimethyl Acetyl	Papaya Trading co,. Ltd (Cambodia)	stem borers, leaf folder, diamond back moth	20–30 ml with 16 L of water	2–4 tanks/ 1000m^2	7	Blue	III
216	Insecticide	N/A	ជង្គរអស់ឫទ្ធិ	Kh	Chlorfenapyr 24% SC	សេះសមុទ្រ៣	worms	20-30ml with 20 L of water	N/A	7	Yellow	II
217	Insecticide	N/A	មមាច68	Kh	Nitenpyram 440g/kg +Buprofezin 150g/kg WDG	សេះសមុទ្រ៣	hoppers, aphids, mealy bugs, white flies	Missing information	N/A	N/A	Blue	III
218	Insecticide	N/A	ស្តេចមមាច	Kh	Nitenpyram 200g/l SL	សេះសមុទ្រ៣	green hoppers, brown hoppers, thrips, bugs, white flies, flea beetle	20–30 ml with 25L of water	N/A	7	Yellow	II
219	Insecticide	N/A	អ៊ី ប៊ី 3.8	Kh	Emamectin Benzoate 3.8 EC	សេះសមុទ្រ៣	mealy bugs, army worms leaf folders, pod borers, defoliators	Missing information	N/A	N/A	Yellow	II
220	Insecticide	N/A	កាដូ	Kh	Emamectin Benzoate 1.9 EC	សេះសមុទ្រ៣	Diamond back moth, defoliators, leaf folders, aphids	Missing information	N/A	N/A	Yellow	II
221	Insecticide	N/A	ចូកា	Kh	Permethrin 50g/l	សេះសមុទ្រ៣	Diamond back moth, stem borers, leaf folders,	Missing information	N/A	N/A	Yellow	II
222	Insecticide	N/A	តូតា	Kh	Permethrin 50% EC	សេះសមុទ្រ៣	mealy bugs, army worms, spiders, pod borers, bugs	Missing information	N/A	N/A	Yellow	II
223	Insecticide	N/A	ទាកគូខ្លាត់ខ្លាយ	Kh	Acetamiprid 20% SP	សេះសមុទ្រ៣	flea beetles, mealy bugs and aphids	Missing information	N/A	N/A	Yellow	II

224	Insecticide	N/A	ចៃក្រៀមស្វិត	Kh	Imidacloprid 70% WP	សេះសមុទ្រ៣	flea beetles, mealy bugs and aphids, thrips and white flies	Missing information	N/A	N/A	Yellow	II
225	Insecticide	N/A	ខ្លាំង១៦៨	Kh	Chlorpyrifos 25% + Amamectin Benzoate 1.5% EC	សេះសមុទ្រ៣	flea beetles, mealy bugs and aphids, leaf folders	30–40 ml with 20 L of water	N/A	7	Yellow	II
226	Insecticide	U-T 77	N/A	Kh	Malathion 50% EC	សេះសមុទ្រ៣	flea beetle, ladybugs, mealy bugs, and aphids	Missing information	N/A	N/A	Yellow	II
227	Insecticide	U-T 70	N/A	Kh	Abamectin 1% + Acetamiprid 3% EC	សេះសមុទ្រ៣	worms, beetles, fruit flies	Missing information	N/A	N/A	Yellow	II
228	Insecticide	Do Do	ដូដូ	Kh	Emamectin Bezoate 5% WDG	សេះសមុទ្រ៣	flea beetle and aphids	Missing information	N/A	N/A	Yellow	II
229	Insecticide	Winner	វីន នឺរ	Kh	Emamectin Bezoate 3% Chlorpyrifos 42%	សេះសមុទ្រ៣	worms and bugs	Missing information	N/A	N/A	Yellow	II
230	Insecticide	Radiant 60SC	N/A	VN	Spinetoram 60 g/L and other elements 1L	Dow AgroSciences	information in Vietnamese	15 ml with 16 L of water or 15 ml with 30 L of water (depend on the level of damage	320 L per ha	N/A	Green	IV
232	Insecticide	Regent 800WG	N/A	VN	Fipronil 800 g/kg and other element	Bayer (vietnam)	information in Vietnamese	0.8 g with 8 L of water	N/A	N/A	Yellow	II
234	Insecticide	Abemecteen 38EC	ម៉ាម៉េចទីន ៣៨EC	Kh	Emamectin Benzoate and other inactive element	Marbo Agricultural International Investment Co., Ltd	bugs, mites, common worms	5–10 ml with 16 L of water	400–500 L/ha	7	Yellow	II
235	Insecticide	(Name in Thai)	N/A	Thai	Organophosphorus	Thailand company	stem borer, diamondback worm, bugs, thrips	N/A	N/A	N/A	Yellow	II
236	Insecticide	Appasa 600EC	អាផាសា ៦០០EC	Kh	Unreadable	ជំរឺខ្មែរ	Diamond back worms, ladybugs, flea beetle	15–20 ml with 16 L of water	400–500 L/ha	7	Yellow	II
237	Insecticide	N/A	អាស៊ីន ៣០០WP	Kh	Acetamiprid 150g/kg and Boprofezin 150g/kg	Cambodian Science Crops	hoppers and ពពួកជញ្ជក់	20–30 ml with 25 L of water	N/A	14	Yellow	II
238	Insecticide	Forbest	ហ្វរបេស	Kh	Abamectin 40g+Emamectin Benzoate 80g+ Indoxacarb50g WDG	Forward Cam International Investment	hoppers, mealy bugs, bugs, thrips, beetles, flea beetles, butterfly	10 g with 25 L of water	120 g/ha	14	Yellow	II
242	Insecticide	Boxer 50EC	ប៊ុកសើ	Kh	Profenofos 50% and inactive elements 50%	ជំរឺខ្មែរ	stem borer, leaf miner, rat, fruit borer, fly worm	20–30 ml with 16 L of water	400–600 ml with 350–500 L/ha	7	Yellow	II
243	Insecticide	N/A	ហ្វូស៊ីខេន	Kh	N/A	N/A	aphids, leaf miner, leaf folder, hoppers, blue worm	15–20 ml with 16 L of water	N/A	N/A	Yellow	II
244	Insecticide	Parida 15EC	ប៉ារីដា ១៥EC	Kh	N/A	Papaya Trading co,. Ltd (Cambodia)	red mite, mealy bugs, aphids, hoppers, bugs	15–20 ml with 16 L of water	N/A	N/A	Green	IV

245	Insecticide	Dupont Prevathon 5SC	N/A	VN	Chlorantranilprole 5% and other elements 95%	Dupont Company (Singapore) Pe., Ltd	information in Vietnamese	15 ml with 16 L of water	0.2–0.6 L with 320–600 L of water/ha	N/A	Green	IV
246	Insecticide	Motsuper 36.0 WG	N/A		Acetamiprid 35% and additional component 64%	Tung Duong Co., Ltd, Impored by Leng Moha Phal Import/ export	blue hoppers and brown plant hoppers	5 g with 16 L of water	N/A	7	Yellow	II
247	Insecticide	NemadeD 60SC	ណេម៉ាដេក	Kh	Chitosan oligosaccharides and DA-6	Sunking Chemical Industrial Co., Ltd	common worm and prevent weed	7–10 ml with 20 L of water	N/A	N/A	Green	IV
248	Insecticide	Acimetin 8.0 EC	N/A	VN	Abamectin 80g/L (Avermectin B1a 72 g/L + Avermectin B1b 8g/L	jiamusi Xing Yu Biotechnological Development Co., Ltd (Vietnamese company)	information in Vietnamese	15 ml with 25–32 L of water	400 L/ha	7	Green	IV
249	Insecticide	N/A	កម្ចាត់គ្មានសល់	Kh	Acetamiprid 400 g/kg, Buprofenzin 35 g/kg, Thiamethoxam 50 g/kg	OSI USA	leaf folder, thrips, silver mite, blue worm, diamondback worm, white fly, red mite	10 g with 16–25 L of water	320–400 L/ha	14	Yellow	II
251	Insecticide	Romeas 77 150EC	រមាស ៧៧ ១៥០ EC	Kh	Indoxacarb 150 g/L	N/A	worms, thrips, bugs, and aphids	6–10 ml with 16 L of water	160–200 ml with 400 L/ha	N/A	Yellow	II
252	Insecticide	Karino 999EC	ការីណូ ៩៩៩ EC	Kh	Chlopyrifos Ethyl 555g/L	N/A	stem borer, worms (living in the soil),	15–20 ml with 8 L of water	0.4–0.5 L/ha with 350–400 L	14	Yellow	II
253	Insecticide	Folitec	N/A	Thai	Pyrethroid, (RS)-a-cyano-4-fluoro-3-phe noxy benxyl (1RS,3 RS;1RS,3SR)-3-(2.2-dichioromny) -2.2 dime thylcyclopropanecarb oxylate	Bayer (Thailand)	information in Thai	25 ml with 20 L of water	N/A	N/A	Yellow	II
254	Insecticide	Visher 25EC	វីស៊ើរ	Kh	Cypermethrin 25% w/w	ក្រុមហ៊ុនភាគហ៊ុនថ្នាំសំលាប់សត្វល្អិតវៀតណាម	rice leaf cutter, and fruit borers on mango	N/A	N/A	N/A	Yellow	II
255	Insecticide	Master Super 300SC	N/A	VN	Alpha Cypermethrin 75g/kg, Indoxacab 75 g/kg, Fipronil 150g/kg	Vietnamese company	(Vietnamese language)	7.5 ml with 16–25 L of water.	400–600 L/ha	7	Blue	III
257	Insecticide	Chlorferan 240SC	N/A	VN	Chlorfenapyr 240 g/l and other 760 g/l	Vietnamese company	stem borers, bugs	15 ml with 16 L of water	400–500 L per ha	7	Yellow	II
258	Insecticide	Emart 50WDG	អ៊ីម៉ាត ៥០WDG	Kh	Emamectin 50g/kg	Cambodian Science Crops	leaf folder, silver mite, blue worm, diamondback, white fly, red mite	10 g with 16–25 L of water	100–200 g/ha	14	Yellow	II
259	Insecticide	Regenusa MY 800WG	N/A	VN	Fipronil 800 g/kg and other elements 200 g/kg	Vietnamese company	information in Vietnamese	1–1.6 g with 16 L of water	400–500 L per ha	14	Yellow	II

260	Insecticide	N/A	កំពូលដង្កូវ	Kh	Fipronil 15 g/L +other element 485 g/L	Golden rice Agrochemicals Company Limited	common worms	40 ml with 16 L of water	320–400 L/ha	N/A	Yellow	II
261	Insecticide	Fila 60EC	ហ្វីឡា ៦0EC	Kh	Abamectin 20g/L + Fipronil 40g/L	Cambodian Science Crops	thrips, mosquito, Leaf folder, defoliator, stem borer, blue worm, army worm, fly worm, fruit borer	50–60 ml with 25 L of water	N/A	N/A	Yellow	II
262	Insecticide	55(Thai language)	N/A	Thai	Organophosphate +pyrethroid	Thailand company	common worm, red ant, mite, aphids	N/A	N/A	N/A	Yellow	II
263	Insecticide	ATYLO 650WP	N/A	VN	Acetamiprid 400g/Kg and Buprofezin 250 g/kg	Hebei Dahu Bio-Chemical Co., Ltd	brown planthopper	4–6 g/L	300 g/ha 400–600 L/ha	15	Yellow	II
264	Insecticide	Methomyl	N/A	Thai	S-methyl N-(methyl carbamoyloxy) + Thioacetimidate 40% SP	Thailand company	common worm	25–30 ml with 25 L of water	N/A	5-7	Red	I
265	Insecticide	Fortazeb 72WP	N/A		Mancozeb 64%, Metalaxyl 8% and other elements 100%	Forward International Ltd	common worm	15–20 g with 1 L of water	1.75–5.20 kg/ha	7	Blue	III
267	Insecticide	Abamectin 1.8% EC	អាបាមេទីន	Kh	Abamectin 1.8% EC	ក្រុមហ៊ុន យូ ធី ក្រុបប្រូធិកសិន	leaf folder, young worm, black mite, thrips, bugs and all type of aphids	40–0 ml with 25 L of water	10–20 tanks per ha	7	Blue	III
268	Insecticide	Hanangkor 40	ហោនអង្គរ ៤0	Kh	Emamectin Benzoate 4% W/V EC, Inactive element 96% and chemical substance “Avermectin”	N/A	lotus worm, defoliator, army worm, blue hopper, diamondback worm, fruit and flower borer, thrips, stem borer, leaf miner, fly	10 ml with 16 L of water for 1000 m^2	N/A	7	Yellow	II
269	Insecticide	MapJONO 700WP	ម៉ែបជូណូ	Kh	Imidacloprid 700 g/kg and inactive element 300 g/kg	Map Pacific Cambodia	leaf minter, thrips and hoppers	N/A	20–40 g with 400–800 L/ha of water	7	Blue	III
270	Insecticide	Lut 55WG (G8)	N/A	VN	Methylamine avermectin 55 gr/kg and other element 94.5%	Dien Khanh (www.dienkhanh.vn)	Diamond back worm	4 g with 16 L of water	80–120 g /ha	N/A	Green	IV
271	Insecticide	Mopride 20WP	N/A		Acetamiprid 20% w/w	HP	hoppers	12–16 with 16 L of water	0.3–0.5 kg/ha	7	Yellow	II
272	Insecticide	Reasgant 3.6EC	N/A	VN	Abamectin 36g/L	Vietnamese company	common worms	N/A	N/A	7	Yellow	II
274	Insecticide	Mekomectin 70WG	N/A	China	Emamectin benzoate 70 g/kg	Jiangsu Fengdeng Pesticides Co., Ltd	worms, mites, hoppers	4.6-6g with 16 L of water	400–500 L/ha	7	Red	I
276	Insecticide	N/A	កុងហ្វូ	Kh	Thiamethoxam 25% WDG	Forward (Cambodia) Ltd	aphids, hoppers, suckers related insect	N/A	N/A	7	Blue	III
277	Insecticide	Apata	អាប៉ាតា	Kh	Apronil 40% + Imidacioprid 40% WDG	ក្រុមហ៊ុន យូ ធី ក្រុបប្រូធិកសិន	white mites, bugs, hoppers, white fly, suckers related insect	15 g with 20 L of water	10–20 tanks per ha	7	Yellow	II

278	Insecticide	Mekomectin 3.8EC	N/A	VN	Emamectin Benzoate 38g/l	N/A (The information is in Vietnamese)	information in Vietnamese	mix 4–6ml with 16L of water;	spray 400–600L/ha	7	Blue	III
279	Insecticide	Mineral Oil 85%	ប្រេងពិសេស	Kh	Mineral Oil 85%	ក្រុមហ៊ុន យូធី ក្របប្រូធិកស៍ន	all type of aphids	100–150 ml with 25 L of water	10–20 tanks per ha	7	Blue	III
280	Insecticide	Arrivo 10EC	N/A		Cypermethrin 10% WV	FMC Corporation USA	common worms	22–35 with 25 L of water	0.5-0.75 L with 400–500 L of water	7	Yellow	II
284	Insecticide	Imitox 20SL	N/A	VN	Imidacloprid 200 g/L	CTY Co Phan Dong Xanh (Vietnam)	brown planthopper and thrip	12–16 ml with 16 L of water	150 ml/ha	7	Yellow	II
286	Insecticide	N/A	អេម៉ាបេន ២.0EC	Kh	Emamectin benzoate 2% and additive element 98%	High Green Company	mites, thrips, brown planthopper, leaf folder, stem borer, aphids, mite, white butterfly, defoliator, leaf miner	20–30 ml with 16 l of water, 30–50 ml with 25 L of water	500–700 ml/ha	7	Yellow	II
287	Insecticide	Cyperan 10EC	(information is in khmer version on number 129)	Kh	Cypermethrin 10% w/w and other element 90%	N/A	N/A	40–50 ml with 25 L of water,	320 L/ha	7	Yellow	II
288	Insecticide	Arin 50SC	N/A	China	Carbendazim 500 g/L and other elemtn 500 g/L	King Tech Cooperation	N/A	16–22 ml with 16 L of water	500 L/ha	7	Blue	III
290	Insecticide	Cyperan 10EC	ស៊ីប៉េរ៉ង់ ១0EC	Kh	Cypemethrin 10% and other soluble element 90%	An Yang Cambodia Plant Protection	Red-hair worm, fruit fly, thrips, blue worm, army worm, leaf folder	40–50 ml with 25 L of water	320 L/ha	7	Yellow	II
291	Insecticide	Formectin-Xtra 54EC	យូ អែហ្វ ស៊ី	Kh	Abamectin 5.4% EC	Forward Cambodia Agro chemical	hoppers, aphids, bugs, thrips, flea beetle, common worm, red mite	10 ml with 18 L of water	150–250 ml/ha	14	Yellow	II
292	Insecticide	SeeSaigon	ស៊ីកសាយហ្គោន	Kh	Cypermerthrin 10% w/w and other element 90%	Saigon Plant Protection Joint Stock	stem borer, leaf folder, leaf miner, army worm, red mite, fruit fly	10–20 ml with 8 L of water	0.5–1 L/ha	N/A	Yellow	II
295	Insecticide	ABA Thai 3.6EC	N/A	Thai	Abamectin and other elements	An Hui JuKai Agrochemical Co., Ltd	bugs, fly, hoppers	4–5 ml with 10 L of water	320–400 L/ha	7	Yellow	II
296	Insecticide	PK 500	ប៉េកា ៥00	Kh	P2O5:30%, K2O:20%, pH 4-4.5	Papaya Trading Co,. Ltd (Cambodia)	N/A	25–30 ml with 16 L of water	N/A	10	N/A	N/A
298	Insecticide	Quiluxny 72EC	N/A	VN	Emamectin benzoate 72 g/L and other element 928 g/L	NG CYEN Biochemistry	leaf folder, spider that damage rice, brown planthopper	10 ml with 16 L of water	100 ml/ha	7	Blue	III
299	Insecticide	LongPH ABA 1.8EC	N/A	China	Abamectin 18g/L and other element 1L	Zhejiang Puihe Agrochemical Co., Ltd	common worm, bugs and fly, stem borer	6–8 ml with 8 L of water	400–500 L /ha	7	Yellow	II
300	Insecticide	N/A	បូណើស	Kh	Chlorpyrifos-Ethyl 40% (W/W) +other elements 60% (W/W)	ក្រុមហ៊ុន ភាគហ៊ុន នក្វូតិច	stem borer, leaf folder, fruit borer, aphids and thrips	20–25 ml with 16 L of water	500 L/ha	14	Yellow	II

301	Insecticide	(Name in Vietnam)	N/A	VN	Abamectin 3.6% and other element 96.4%	Jiamusi Xingyu Biotechnological Development Co., Ltd	(Vietnam)	3–4 ml with 8 L of water	400–500 L/ha	7	Yellow	II
302	Insecticide	Cyrux 25EC	N/A		Cypermethrin 25% w/w and other element 25% w/w	N/A	N/A	4–5 ml with 8 L of water	0.2–0.8 L/ha	14	Yellow	II
304	Insecticide	Forfezin Pro 400WP	ហ្វ័រហ្វេីន ៤០០ WP	Kh	Buprofezin 300g/kg+ Imidacloprid 100g/kg	Forward (Cambodia) Ltd	bugs, brown plant hopper, thrips, butterfly, worms	5.5–8.5 g with 16 L water	110–170 g/ha	14 Day	Blue	III
305	Insecticide	Biobit 32B FC	N/A	VN	Bacillus Thuringiensis	Vietnamese company	Vietnamese launguage	10 g with 8 L water	1–2 kg per ha	N/A	Green	IV
306	Insecticide	Fungfu 0.1GR	ហ្វុងហ្វូ 0.1GR	Kh	Triacontanol 0.1% w/w	ក្រុមហ៊ុន ហ្វ៊ីនលែន & លីហ្វផេសធីសាយ	N/A	60 ml with 20 L water	N/A	N/A	Blue	III
307	Insecticide	Quiluxny	N/A	VN	Emamectin Benzoate 6% w/w	Vietnamese company	worms, diamondback worm, bugs	7.5 g with 16 L water	0.1–0.15 kg per ha	N/A	Yellow	II
308	Insecticide	EMEC	អ៊ីមិច 50WG	Kh	Emamectin Benzoate 5% wg	ក្រុមហ៊ុន ហាយ ហ្វ៊ីន ខ្ញុំអិលធីឌី	Diamondback worm, fruit borer, leaf borer, thrips	20–5g with 25 L water	0.3–0.5 kg/ha	N/A	Yellow	II
309	Insecticide	No Insect	ដំណាំគ្មានដង្កូវ	Kh	Avermectin	Shieng Hai Agri Dever Co., Ltd.	Diamondback worm, fruit borer, leaf borer, thrips	600–800 ml	300–400 L	N/A	Yellow	II
310	Insecticide	Romeas 168	រមាស ១៦៨	Kh	N/A	N/A	N/A	4–5 ml with 8–10 L water	400–500 L per ha	N/A	Blue	III
311	Insecticide	Mataxyl 500WP	ម៉ាតាស៊ីល	Kh	Matalaxyl 500g/kg	Mappacific	aphids, other diseases	20–25 g with 16 L water	400–500 L per ha	N/A	Green	IV
312	Insecticide	Romong Boowf	រ៉ូម៉ង់	Kh	N/A	Kamhero Agriculutre Ltd.	aphids, other diseases	50–60 g with 20 L water	N/A	N/A	Blue	III
313	Insecticide	N/A	ផ្កា ផ្លែស្អាត ១០០%	Kh	Mancozeb 64%, Metalaxyl 8%	កសិករជោគជ័យ	aphids, other diseases	50–60 g with 18 L water	1.5–3 kg per ha	N/A	Blue	III
315	Insecticide	N/A	ដង្កូវងារ	Kh	Emamectin Benozoat 4% EC/ Solvent 96%	ខ្មែរអង្គរ	N/A	25 L of water per bottle	N/A	7	Yellow	II
316	Insecticide	Emectin 40 EC	N/A	VN	Emamectin Benozoat 40g/L	Vietnamese company	N/A	N/A	75–100 ml for 400–500 L of water per ha	N/A	Blue	III
317	Insecticide	Missing information	N/A		Emamectin Benozoat 72g/L	N/A	leaf folder, mite, brown plant hopper	10–15 ml for 16 L water	N/A	N/A	Blue	III
318	Insecticide	40EC	ហ្វ៊ូរជី	Kh	GA3 4% EC	ហ្វ៊ូរ ជើង ខេម អ៊ិនធើណេសិនល	N/A	4–6ml for 25 L water	N/A	N/A	Blue	III
319	Insecticide	Cartisvin	កាទីស៊ីន	Kh	Garbendazin + Inactive element	N/A	N/A	N/A	600–700 ml for 400-500 L water per ha	7	Green	IV
320	Insecticide	Abamectin	N/A		N/A	N/A	bugs	N/A	N/A	N/A	Yellow	II

321	Insecticide	Khaten	ខាថេន	Kh	N/A	ខេមហេរ៉ូ	bugs, brown plant hopper, thrips, aphids, white fly, fruit borer	15–16 ml for 16 L water	N/A	7	Blue	III
322	Insecticide	Fertile	ហ្វឺថាល ល្អ	Kh	Zn: 5%, B: 2.5%, Fe: 2%, Mo: 0.5%, Mg: 0.5%, Cu: 0.5%	ជំរឺខ្មែរ	N/A	10 ml for 16 L water	150–250 ml for 500–1000 L water per ha	N/A	Green	IV
323	Insecticide	B-41	បេ ៤១	Kh	Thiamethoxam 250 g/kg Acetamiprid 100 g/kg Inactive element 650 g/kg	ផ្កាឈូក	hopper, thrips, brown plant hopper, fruit borer	N/A	N/A	7	Blue	III
325	Insecticide	Marrigold	N/A	Kh	Oxolinic Acid: 200g/kg Streptomycin: 50g/kg	Pesticide SAMAKI Co.,Ltd	bacteria related diseases	20 g for 16 L water	N/A	7	Blue	III
326	Insecticide	Mangold	N/A	Kh	Azoxystrobin: 80 g/kg Propineb: 600 g/kg	Pesticide SAMAKI Co.,Ltd	bacteria related diseases	50 g for 16 L water	N/A	7	Blue	III
328	Insecticide	Anna	អេនណា	Kh	Mancozeb: 680 g/kg Metalaxyl: 40 g/kg Cymoxanil: 30 g/kg	Kenvos Biology (Cambodia) Co., Ltd	bacteria related diseases	60–80 g for 25 L water	N/A	14	Blue	III
330	Insecticide	ATOMIK	អាតូមិក	Kh	Sodium-S-Nitrogualacolate 0.03%, Sodium-O-Nitrophenolate; 0.06%, Sodium-P-Nithrophenolate: 0.09%	Mabro Agricultural Internation Investment Co., Ltd	N/A	10 ml for 16 L water	150–200ml for 500–1000 L water per ha	N/A	Green	IV
331	Insecticide	BIMZOO	ប៊ិមហ្សូ	Kh	Bismertiazol: 250 g/kg	Cambodian Science Crops	bacteria related diseases	40–50 g for 16 L water	N/A	N/A	Green	IV
332	Insecticide	Romin	រ៉ូមីន	Kh	N/A	ខេមហេរ៉ូ	bacteria related diseases	50 g for 16 L water	N/A	7	Blue	III
333	Insecticide	Bonny 4SL	ម៉ូននី ៤SL	Kh	Ningnanmycin: 40 g/L	N/A	fungus related disease, bacteria,	30 ml for 16 L water	0.75 L for 400 L water per ha	7	Green	IV
334	Insecticide	Somlab	សំលាប់	Kh	Emamectin Benzoate 5% EC	N/A	Diamondback worm	15–25 ml for 25 L water	N/A	7	Yellow	II
335	Insecticide	Penny	N/A		Chlorpyrifos Ethyl 600g/L Cypermerthrin 100 g/L,	N/A	N/A	9–10 ml for 25 L water	600 L per ha	N/A	Yellow	II
336	Insecticide	Tatimec	N/A	Kh	Abamectin 18 g/L	ជំរឺខ្មែរ	red mite, bug, stem borer	10–15 ml for 16 L water	300–500 ml for 400–500 L water per ha	7	Blue	III
337	Insecticide	Footsur	N/A	Kh	Abamectin 30 g/L Etiamectin Benzoate: 35 g/L Other element: 945 g/L	ក្រុមហ៊ុនពាណិជ្ជកម្ម នុង យៀង	Diamondback worm, bug, army worm	Missing information	N/A	N/A	Yellow	II
338	Insecticide	Deco Alpha	ដេកូអាល់ហ្វា	Kh	Cypermerthrin: 50 g/L Inactive Element: Additional element: 1L	N/A	leaf folder, mite, brown plant hopper	N/A	N/A	7	Yellow	II

339	Insecticide	Hopsan	ហប់សាន់	Kh	Phenthoate: 45% Fenobucoat: 30%	N/A	missing information	Missing information	Missing information	N/A	N/A	N/A
340	Insecticide	Golden Dragon	ហ្គោលដិន ដ្រាហ្គន	Kh	N/A, Cypermerthrin: 55g/L Other Element	Leng Mohaphol Import Export	leaf folder, leaf miner	5–7 ml for 16 L water	N/A	N/A	Yellow	II
341	Insecticide	Tigon	ទីហ្គន	Kh	Indoxacarb: 150g/L	N/A	Diamondback worm, stem borer, butterfly	Missing information	N/A	N/A	Yellow	II
342	Insecticide	Fetrilon Combi	ហ្វីទ្រីលន ខមប៊ី	Kh	Amino Acid	គោខ្មែរ	N/A	3 g for 16 L water	N/A	N/A	Blue	III
343	Insecticide	N/A	អូស៊ីន 20WP	Kh	Dinotefuran 200 g/kg	Agrotechvita Co., Ltd	flea beetles, aphids, white fly	6.5 g with 16 L of water 2 tanks for 1000 m^2	N/A	1–3	Blue	III
344	Insecticide	N/A	សេដ្ឋី	Kh	Metalaxyl 80 g/kg + Mancozeb 640 g/kg	N/A	diseases	30–80 g for 20 L water	N/A	14	Blue	III
345	Insecticide	Ruran	រ៉ូរ៉ន	Kh	Dinotefuran 20% WP	Sinamyang Group	Diamondback worm, thrips, brown plant hopper, army worm, white fly	N/A	0.2–0.4 kg with 320–360 L per ha	7	Blue	III
346	Insecticide	Henbapoun	ហេន បាពូន	Kh	Emamectin bezoate: 5% w/w. Lambda cyhalothrin: 10% w/w.	ហេន ចេន អិនវេសមិន	Diamondback worm, thrips, brown plant hopper, army worm, white fly	1 pack with 16 L water	N/A	14–21 days	N/A	N/A
347	Insecticide	Comando	កម្ម៉ង់ដូរ	Kh	Propineb 640 g/kg Azoxystrobin 80g/kg	N/A	fungus related disease, bacteria,	50–60 g with 25 L water	320–600 L water per ha	N/A	Blue	III
349	Insecticide	RIDOZEB 72WP	រីដូហ្សែប ៧២ WP	Kh	Mancozeb 64% w/w Metalaxyl 8% w/w	N/A	N/A	N/A	N/A	N/A	Green	IV
350	Insecticide	Thnot 800WDG	ត្នោត	Kh	Pymetrozine 600 g/kg Nitenpyram 200 g/kg	សាខាក្រុមហ៊ុន ហាយអូវ សាយហ្គន	thrips, hoppers, aphids	1 pack 10 g with 16–30 L water	320–500 L water per ha	N/A	Blue	III
353	Insecticide	Mame	ម៉ាមេ	Kh	Mancozeb 64% WP Metalaxyl 8% WP	Sinamyang Group	fungus-related disease, bacteria,	40–50 g for 16 L water	800 g per ha	10 days	Blue	III
354	Insecticide	N/A	រី ហ្គេន	Kh	Abamectin 3.6% WP	N/A	leaf miner, silver mite, thrips, diamondback worm	10–15 ml for 16 L water	N/A	N/A	Yellow	II
356	Insecticide	Avatar	អាវ៉ាតា	Kh	Oxadiazine-4a(3H)-carboxylate: 30% W/W	Agrotechvita Co., Ltd	leaf miner, fruit borer, thrips, diamondback worm, army worm	1.5–2 packs per 16 L water	N/A	N/A	Yellow	II
358	Insecticide	Havest B	ហាវេស B	Kh	Boron: 11%	N/A	N/A	15 ml for 25 L water	N/A	N/A	Blue	III
359	Insecticide	Nato	ណាតូ	Kh	Chlorpyrifos: 50% + Cypermethrin 50%	N/A	leaf miner, fruit borer, thrips, diamondback worm, army worm	N/A	0.5–0.6 L per ha	N/A	Yellow	II
360	Insecticide	Fomin 500WP	ហ្វូ មីន	Kh	Fosetyl -aluminium 800g/kg	Cambodian Science Crops	fungus-related disease, bacteria	40–50 g with 16 L water	N/A	7 days	Green	IV
362	Insecticide	Chamnap	ចំណាប់	Kh	Mancozeb 800 g/kg	Cambodian Science Crops	fungus-related disease, bacteria	50–100 g with 16 L water	N/A	7 days	Green	IV

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