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Research Article

The Effect of Farmers' Knowledge in Chemical Insecticides Resistance to Control Plutella Xylostella

Catur Hermanto[1], Rasiska Tarigan[2*], Fatiani Manik[2]

[1]Balai Penelitian Tanaman Sayuran – Badan Penelitian dan Pengembangan Pertanian Jln Tangkuban Perahu No 517, Lembang, Bandung Barat 40391
[2]Kebun Percobaan Berastagi, Balai Penelitian Tanaman Sayuran, Jl. Raya Medan-Berastagi Km. 60 Sumatera Utara

Abstract

The Farmers and pesticides are important aspects that interrelated tocontroll pests in the field of plant diseases as well as opportunities occur resistensi. The use of pesticides by farmers is constantly increasing, especially in the highlands, but this increase is not offset by an understanding in the use of pesticides. The aimed of the research to find the knowledge and the use of insecticide resistance cabbage farmers in Karo District. The research was conducted at the laboratory of Berastagi experimental farm with altitude of 1,340 meters above sea level implemented from the month of September to November 2015. The implementation of divided by 2 (two) stages. The first is to collect issues by discussion technique of farmers group and diluent and interview using a questionnaire. Total number of respondents is ten peoples each four districts. From the questionnaire result so the selected types of insecticides often used by famers for the testing of sensitivity plutella xylostella to insecticides test at laboratory scale with four treatment. each consisting of 9 degree of concentration using a completely randomized design and repeated 3 times. each consisting of 9 degree of concentration using a completely randomized design and repeated 3 times. The results showed cabbage farmers in the county karo mixing fungi and insecticides> 2 types with spraying frequency of 2 x 1 week as well as the doses used did not correspond to the recommended KF. LC 50 value of the chemical insecticide active ingredient klorantranilipro, prefenofos, sipemetrin and kloropinofos successively 1.87 ml, 1.5 ml, 1.5 ml and 2 ml. Time and time required to shut down 50% of Plutella xylostella (LT 50) of the four chemical insecticide active ingredient klorantranilipro, prefenofos, sipemetrin and Kloropinfos are respectively 39.20, 19:43, 23:57 and 30.15 hours

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Corresponding Author: Rasiska Tarigan, Kebun Percobaan Berastagi, Balai Penelitian Tanaman Sayuran, Jl. Raya Medan- Berastagi Km. 60 Sumatera Utara

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Introduction

Farmers play an important role in maintaining plants in the field. The level of knowledge of farmers to use chemical insecticides is closely related to the success of controlling pests in the field. The level of knowledge of farmers is in line with the habits of farmers using insecticides that often violate the rules of use, such as excessive doses, mixing several types of pesticides and the frequency of intensive spraying, this action is very detrimental to human health and over time can increase the probability of secondary plant pest organisms or increase pest resistance (Vander 2001 in Ameriana M, 2008).

Cabbage is a horticultural crop with high economic value and is an exported vegetable. Problems that are often found are factors that reduce the production of cabbage in the field, including diseases, pests, and weeds. Pests that attack cabbage can be divided into two parts, primary pests, and secondary pests. Plutella larvae. Xylostella L and Crocidolomia are the two main types of pests of cabbage plants in the dry season (Udi et al 2014). In Indonesia, P. xylostella attacks in the dry season can result in crop losses of up to 100% (crop failure) without using insecticides (Winarto and Nazir, 2004). One way to control these pest attacks is by insecticides. Farmers intensively use good insecticides using various types of insecticides both single and mixed with high doses and short spray intervals every 2-3 days (Koster 1990).

Survey and respondent results in the Karo district show that cabbage farmers often use prevathon (chlorantraniliprole), curacron (profenofos), Sherva (sipermetrin), dursban (chlorpyrifos), and decis (deltamethrin). Based on survey results in Karo district, North Sumatra province, the behavior of farmers in mixing fungicides and insecticides together with more than 2 species reached 80%. This behavior is often found in cabbage farmers in controlling the caterpillar plutella xylostella. This is because farmers have the perception that mixing pesticides together by increasing ½-1 dose than recommended is more effective than using a single insecticide. The frequency of spraying is done by Karo farmers twice a week. This is because in the highland farmers are more intensive in using insecticides. According to Alen et al (2015), intensive use of fungicide-insecticides in the highlands with extreme weather causes resistance, resurgence, and pest outbreaks.

Monitoring the use of insecticides by farmers in the field is necessary to determine the sensitivity of caterpillar plutella xylostella to several chemical insecticides that are often used by cabbage farmers in Karo district. This study aims to determine the effect of the level of knowledge of Karo farmers on the resistance of several insecticides in controlling caterpillar plutella xylostella plants.

Materials and Methods

Time and place

The study was conducted in September 2016 to November 2016 in the Karo district and the Berastagi experimental garden pest disease laboratory (1340 m asl).

Scope

The scope of this research includes (a) Data collection on distributors and farmers in 4 districts of Karo Regency; Dolat rayat, Berastagi, Namanteran and Kabanjahe with the

respondent system. The respondent approach is cross-sectional study. The results of the survey data of several chemical insecticides used by cabbage farmers were tested on caterpillars plutella xylostella to see LC50 and LT50. Data collection using a questionnaire included the type of insecticide, the concentration of the formulation, the spraying interval, knowledge of the working code of the insecticide used, and the intensity of the attack of the cabbage plants caused by plutella xylostella.

Insect Propagation

Larvae (caterpillars) on chili, potato, and cabbage used in this study were obtained from the location of farmers in instar 3-4 and propagated at the screen house, KP. Berastagi.

Trial Testing is carried out in the Laboratory

The plutella xylostella caterpillars used in this study were the first generation in 2-3 instars. Plant insecticide test was carried out by dipping method. The insecticide tested was dissolved in aquadest according to the recommended concentration, then the serial concentration at 4 levels above the recommended concentration and 4 levels down was determined. Small pieces of cabbage leaves are dipped into each concentration of lartan insecticide for 10 seconds, then drained, air-dried and stored in small jars. A total of 10 instar 3 plutella xylostella larvae that had been fasted for 3 hours were put into a jar. The number of dead larvae was counted 1, 2,4, 8, 24, 48, 72 hours after application

Observation Parameters

Survey data from the determination of the type of insecticide used by Karo farmers in the field In the first stage of the experiment, observations were made on the mortality of cabbage caterpillars at 1, 2, 4, 8,10, 24, 32, 40, 48, 72 hours after application.

Percentage mortality of larvae is calculated by the formula

$$nNx\ 100\%$$

Information:
P = Percentage of P. xylostella mortality
n = Number of dead larvae
N = Initial number of larvae tested
(Strange, 2003 in Hani, 2014).

Results and Discussion

Survey on Determination of the Type of Insecticide used by Cabbage Farmers in Karo District

Based on data from the Karo Regency official district Dolat Rayat, Berastagi, Tiga Panah and Kabanjahe districts are the centers of cabbage fields. The type of insecticide, formulation concentration, spraying interval commonly used by cabbage farmers and knowledge of work codes in the 4 districts of Karo district are presented in Table 1.

Table 1. Farmer's level of knowledge of the type and amount of insecticide used, frequency of spraying, the dosage used by farmers, as well as the working code of insecticide in controlling caterpillars plutella xylostella

Insektisida (Insecticide)		(Number of Famers in subdistric				Total 40
Name	Active Compound	Dolat Rayat n=10	Berastagi n = 10	Tiga Panah n = 10	Kabanjahe n = 10	100%
Prevathon	Klorantraniliprol	4	4	3	2	32,5%
Curacron	Profenofos	2	3	3	3	27,5%
Dursban	Kloropinfos	1	1	2	2	15%
Sherva	Sipemetrin	1	1	1	2	12,5 %
Decis	Deltrametrin	2	1	1	1	12,5%

Combination of insecticides

Combination of Insectisides	(Number of Famers in subdistric				Total 40
	Dolat Rayat n=10	Berastagi n = 10	Tiga Panah n = 10	Kabanjahe n = 10	100%
1 jenis insektisida/fungisida	2	1	3	2	25 %
2-3 jenis Insektisida/Fungisida Secara Sendiri-sendiri	-	1	3	3	17,5%
4-5 Jenis Insektisida/Fungisida Secara Sendiri-sendiri	2	-	-	-	5 %
Mencampurkan fungisida dan insektisida bersamaan lebih dari 2 jenis	6	8	4	5	62,5%

Insectiside sprying frequency

Insectiside sprying frequency	Number of Famers in subdistric				Total 40
	Dolat Rayat n=10	Berastagi n = 10	Tiga Panah n = 10	Kabanjahe n = 10	100%
1x1 week	3	2	2	2	22,5%
2x1 week	4	5	3	3	37,5%
3x1 week	1	1	1	1	10%
4x1 week	1	1	1	1	10%
1x2 week	1	1	2	1	12,5%
Others	-	-	1	2	7,5

Dosage/concentration of insecticides

Dosage/concentration of insecticides	Number of Famers in subdistric				**Total 40**
	Dolat Rayat n=10	**Berastagi n = 10**	**Tiga Panah n = 10**	**Kabanjahe n = 10**	**100%**
KF as prescribed by manufacturer	3	4	3	3	**32,5%**
¼ of prescribed by manufacturer	3	3	1	1	**20%**
½ of prescribed by manufacturer	3	2	4	4	**32,5%**
1x prescribed by manufacturer	1	1	2	2	**15 %**

Understanding Work Code of Insectisides Application	Jumlah Petani di Kecamatan (Number of Famers in subdistric)				Total 40
	Dolat Rayat n=10	**Berastagi n = 10**	**Tiga Panah n = 10**	**Kabanjahe n = 10**	**100%**
Yes	4	5	3	1	**32,5%**
No	6	5	7	9	**67,5%**

In Table 1. It shows that 32.5% of cabbage farmers in Karo District use the active insecticide chlorantraniliprol, followed by Profenofos, Chloropinfos, and Sipemetrin. In general, cabbage farmers in Karo Regency mixed fungicides and insecticides over 2 types of fungicides and insecticides with a percentage of 62.5%, followed by single and non-single spraying between insecticides and fungicides with a percentage of 25%. This shows that cabbage farmers in the district are more likely to mix fungicides and insecticides together with more than 2 types to save on farming costs, especially on labor costs, and single spraying is expected to control pests and diseases simultaneously in the field.

The habit of the Karo cabbage farmers is in accordance with the level of knowledge about the insecticide working code which is still low with a percentage of 67.5% so that the control of plutella xylostella caterpillar attacks is less effective. If two chemical formulas (active ingredients) with different working groups are mixed in one solution, they will produce different formulas and their effectiveness is reduced. According to Moekasan (2007), a mixture of insecticides with other active ingredients or other chemicals (fungicides), can cause synergistic, antagonistic or neutral effects, and have an impact on increasing pest populations, secondary pathogens, emergence of new pests, pest resistance or disease resistance to pesticides, annihilation biological agents and predators.

Chemicals or insecticides have a neutral effect if they do not produce insecticide poisons when mixed and can overcome the problem of pest resistance. According to Falairo 2006, intensive use of insecticides can stimulate the phenomenon of weakening the carrying capacity of the environment to natural products, so we need alternative methods that are more environmentally friendly, such as using botanical insecticides.

The frequency of spraying carried out by cabbage farmers in Karo district based on respondents, which is as much as 2 times a week with a percentage of 37.5% followed by single spraying in a week that reached 22.5%. This shows that the frequency of spraying is related to climatic conditions and the intensity of crop damage. Climatic factors including temperature, humidity, sunlight, changes in the rainy season to dry can affect the development of pest populations and the development of pathogens (Anderson et al, 2004; Bonaro et al, 2007: Shelton, et al 2000). This makes farmers assume to increase the frequency of spraying.

The knowledge of cabbage farmers on the level of pest attacks carried out by controlling plutella xylostella

The results of respondents in Table 2, shows the knowledge of cabbage farmers in Karo district on the level of pest attacks in controlling plutella xylostella is very low.

Table 2. Cabbage farmers' knowledge of the level of attack carried out by controlling plutella xylostella (Knowledge of cabbage farmers about how the level of attacks to control Plutella xylostell).

Attack Rate	Number of Famers in subdistric				Total 40
	Dolat Rayat n=10	Berastagi n = 10	Tiga Panah n = 10	Kabanjahe n = 10	100%
1/16 of Total Plants	5	4	5	4	45%
1/8 of Total Plants	2	2	3	3	25%
1/4 of Total Plants	2	2	1	2	17,5%
1/2 of Total Plants	1	2	1	1	12,5%

Pesticides are only used if the pest population has damaged or exceeded the economic control threshold. Cabbage farmers in Karo district use chemical insecticides intensively and incompatible when the attack rate reaches more than 25% so the chances of resistance and residue occur are very high.

In the respondent data, four sub-districts representing cabbage plant centers in the Karo district. When the attack rate was 1/16 of the total number of plants, farmers used chemical insecticides to control plutella xylostella caterpillars reaching 45%.

This is very related to the perspective of farmers, who consider the effectiveness of insecticides is if the day after spraying insecticide the effective indicator can be contaminated. According to Basuki (2009) one indicator of effectiveness is dead caterpillars, caterpillars do not want to eat, eggs fail to hatch, caterpillars turn yellow or caterpillars die on day 5 after application.

Chemical insecticide resistance test at Laboratorim with LD50 method

Resistance test results at 1,2,4,8,10, 24,40,48 and 72 hours after the treatment of insecticide Prevathon (chlorantraniliprol), Curacron (Prefenofos), Sherva (Sipemetrin) and Dursban (Klorpinofos) against caterpillar insecticide xylostella cabbage plants in Karo district in table 3.

Probit analysis results showed that each chemical insecticide tested in the laboratory had different LC50 values. Chemical insecticide with faster time to kill the caterpillar plutella xylostella seen in Prefenopos that is 8 hours after treatment, while the insecticide with a long time to produce LC above the threshold 50 is Chlorantranilipro. This is in accordance with the recommendations of the product brands listed in controlling plutella xylostella.

The effectiveness of an insecticide in controlling plutella xylostella larvae is closely related to the rate of increase in mortality with time after treatment. In Figure 1. and Table 2. can be seen a graph of each chemical insecticide treatment, in general the increase in the percentage of mortality rate is directly proportional to the increase in concentration. In 48 and 72 hours after the treatment of chemical insecticides with active ingredients, Chlorantranilipro had a significant increase in mortality rate above the 50% threshold at a concentration of 1.12 followed by Sipermetrin, Chlorphyripos, and Chlorantranilipro.

Table 3. LC.50 values of single chemical insecticides against plutella xylostella larvae at 8 24, 48 and 72 hours after treatment

Perlakuan/ traeatments	Konsentrasi (Concentrations)	Mortalitas *plutella xylostella* (%) pada…JSP (Mortality of broad plutella xylostella on cabagge)….HAE											
		8			24			48			72		
		LC 50	Ficidual limit	STEDEV	LC 50	Ficidual limit	STEDEV	LC 50	Ficidual limit	STEDEV	LC 50	Ficidual limit	STEDEV
Klorantraniliprо	0	0	0		0	0		0	0		0	0	
	0,37 ml	0	0		0	0		1,875	-11,2542 - 9,02784		3.40	27.8297 – 19.6975	
	0,75 ml	0	0		2.885	-7.22981 - 10.7426		5.493	-3.42762 - 12.5750		8,741	-3,7891 - 10,5673	
	1,12 ml	0	0		35.31	29.5472 - 40.1760		37.20	32.0846 - 41.6108		38.4150	36,451 - 43,026	
	1.5 ml	0	0	0	48.70	44.4865 - 52.9790	5.36301	50.07	56.2104 - 64.0286	6,425	69.7841	63,702 - 71,639	8,0243
	1,87 ml	0	0		78.68	73.8704 - 84.3891		79.61	75.1236 - 84.8852		79.75	73,713 - 85,027	
	2,24 ml	0	0		97.36	90.9863 - 105.402		97.8813	91.9424 - 105.238		111.100	107,548 - 119,684	
	2,61 ml	0	0		116.04	107.718 - 126.800		116.14	108.428 - 125.925		136.109	128,312 – 140, 922	
	2,98 ml	0	0		136.02	125.441 - 149.871		135.66	125.908 - 148.215		152,04	143,720 - 163,092	
Prefenofos	0	0	0		0	0		0	0		0	0	
	0,39 ml	0	0		0	0		17,84	-7,842 - 15,671		21,462	7,028 - 15,452	
	0,76 ml	0	0		23.32	16.8585 28.3029		24.1269	17.7926 29.0169		25.0405	18.9488 - 29.7741	
	1,3 ml	0	0		47.76	44.330 - 50.947		48.8535	45.4873 52.0209		50.0278	46.7720 - 53.1464	
	1,5 ml	21.3548	14.4269 - 26.6339	4.422	70.61	66.754 - 75.367	7.220	71.9649	68.0030 76.892	7.295	96.7378	90.1820 - 105.439	10,26
	1,87 ml	45.9845	42.3510 - 49.2650		93.45	87.190 - 101.77		95.0763	88.6298 103.652		121.725	112.062 - 134.753	
	2,74 ml	69.0052	65.2011 - 73.6675		117.8	108.58 - 130.50		119.803	110.257 132.724		150.968	137.524 - 169.207	
	2,61 ml	92.0259	85.8145 - 100.307		146.5	133.44 - 164.28		148.741	135.412 166.90		191.524	172.746 - 217.077	
	2,98 ml	116.656	107.329 - 129.347		186.1	167.83 - 211.24		188.873	170.202 214.399		196.981	177.483 - 223.523	
Sipemetrin	0	0	0		0	0		0	0		0	0	
	0,39 ml	0	0		0	0		16.216	-0.65079 - 27.135		29.5490	19.9227 - 36.8200	
	0,76 ml	0	0		35.9204	22.988 - 45.5872		47.364	31.1383 - 49.5440		52.0164	45.5611 - 58.0819	
	1,3 ml	0	0	0	44.0815	43.262 - 63.374	10.832	62.853	54.7849 - 72.207	10.8517	71.2140	64.9158 - 78.8017	12,739
	1,5 ml	0	0		70.242	60.277 - 84.421		82.937	73.415 - 96.862		89.1575	81.2569 - 99.9172	
	1,87 ml	0	0		88.603	76.210 - 109.211		103.02	90.4587 - 123.104		107.101	96.8537 - 121.777	
	2,74 ml	0	0		110.091	93.652 - 139.42		124.51	108.048 - 151.824		126.299	113.202 - 145.504	

If the concentration reaches LC 50 is greater than the recommendations contained in the product and the resulting time is very long, the possibility of resistance and toxicity is very high. In terms of the working code Curacron insecticide has a way of working classified in the IB.

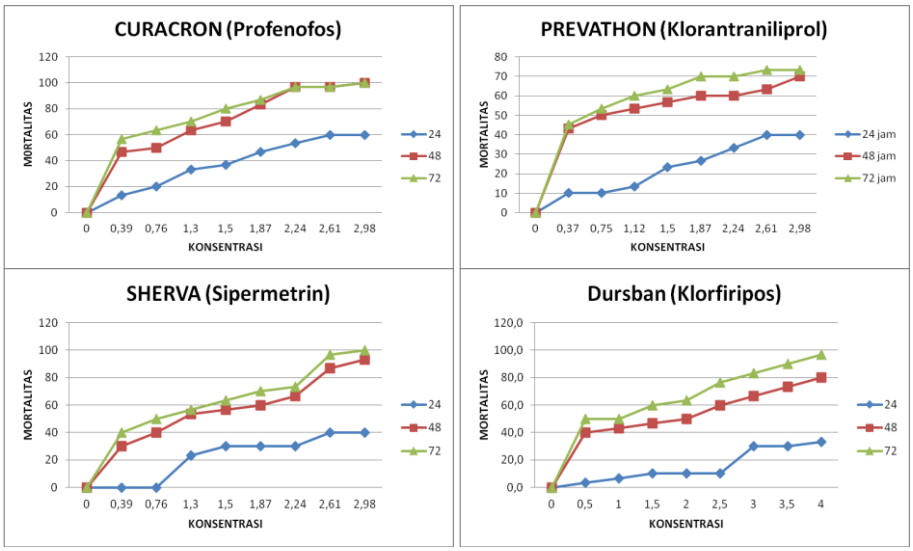

Figure 1. LT50 values of four types of plant chemical insecticides against caterpillar plutella xylostella cabbage

Based on LT50 values of the four types of chemical insecticides used by cabbage farmers in Karo District, there was a difference in time to kill 50% of plutella xylostella pests (Table 2). The shortest time to kill 50% of plutella xylostella pests is obtained from the chemical insecticide treatment with active ingredients chlorantranilipro.This shows that insecticide with active ingredients, Profenofos, is an active ingredient that is able to control insects that attack vegetables and is classified as an environmentally friendly organophosphate pesticide. According to Alen et al, 2015, profenofos is a digestive poison when it enters into insects will cause interference with digestive function with a fast reaction.

Table 4. LT50 values of four types of plant chemical insecticides against caterpillar plutella xylostella cabbage (LT50 value of four plants inceticides chemical to plutella xylostella on cabbage)

Application	**LC50 (ppm)***	***Fisidual limit***	**Chi Square**	**Stadev**
Klorantranilipro	39,20	28,45-43,17	4,42	8,66
Prefenofos	19,43	15,82-26,40	2,53	11,91
Sipemetrin	23,57	18,73-29,53	3,17	7,45
Kloropinfos	30,15	22,01-35,66	2,80	8,02

The ability of an insecticide is affected by the nature of the host resistance and the conditions of the host microenvironment. The time needed to cause insect death depends on the virulence of the pathogen, the nature of the host resistance gene and the conditions of the microenvironment in the host (Pachamuthu and Shripatt (2000); Sastrosiswoyo and Rubiati,

(2001)). In the use of chemical insecticides, it is necessary to alternate between active ingredients that are different in their class and work system, according to the label dosage rules so that pest resistance in the field can be prevented.

Conclusion

The level of knowledge of cabbage farmers in Karo district on the type of insecticide, the concentration used, the frequency of spraying, the dose used by farmers, as well as the working code of the insecticide in controlling plutella xylostella caterpillars is still low and not in accordance with the recommended KF. LC 50 values of chemical insecticides from active ingredients such as chlorantranilipro, prefenofos, ciphetrin and chloropinfos are 1.87 ml, 1.5 ml, 1.5 ml, and 2 ml, respectively. The time to inhibit 50% of plutella xylostella (LT 50) from the four chemical insecticides with active ingredients as chlorantranilipro, prefenofos, ciphetrin and chloropinfos were 39.20, 19.43, 23.57 and 30.15 hours.

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