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Distribution of Types and Management of Insecticides Based on Technical Applications in Palu Local Shallots

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ABSTRACT

This study aims to determine the distribution of insecticides and the doses used in local shallots cultivation in Palu valley. This research took place from May to July 2021. This study used a descriptive observational method, describing the condition of farmers in using pesticides on local Palu shallots. Respondents were selected based on their daily activities as local Palu shallot farmers in Palu valley, Palu, Central Sulawesi. Determination of respondents was done using Simple Random Sampling; the total respondents taken were 40 farmers (about 10 people at each site), considering that the sample size could represent the existing population (population condition was homogeneous). Quantitative data were analyzed using a simple cross-tabulation analysis which was then interpreted. The study results showed that Farmer's activity in the local shallot cultivation was inseparable from the use of insecticides in controlling herbivorous insects (95% farmers). Insecticide usage in the Palu Valley area was 67.5% with a frequency of 1 - 3 times a week, and 17.5% were applied without heeding the prescribed usage recommendations. There were 16 types of insecticide trademarks circulating in Palu valley, including 3 types in the Maku area, 6 types in Soulove, 4 types in Bolupontu Jaya, and 1 type in Wombo. Insecticide application was mostly in the morning (60-100%), 1 - 3 times a week (67.5%), and without rules of use by 17.5%.

1. INTRODUCTION

Farmers are the largest working group in Indonesia. Although there is a downward trend, the labor force working in the agricultural sector still accounts for around 40% of the workforce. Many districts in Indonesia rely on agriculture, including plantations, as the primary source of regional income (in Indonesia: Penghasilan Utama Daerah, abbreviated as PAD) [1]. The development of local Palu shallots is a top priority for the Central Sulawesi government, one of the agricultural sector's leading commodities. The problem that often hinders farmers in developing shallot farming in the Palu valley is the attack of plant pest organisms (PPO). Pest attacks are often the leading cause of farmer failure, causing socio-economic losses. Often farmers do not enjoy their agricultural products and even do not get any yield [2-4].

Pest control based on a global perspective consists of five eras, pre-pesticides, optimism, doubts, technology-based of Integrated Pest Management, ecology-based of Integrated Pest Management. (a) Pre-pesticide, at this time, pest control is carried out by farming; biological control is based on an understanding of pest biology. This method has been carried out in Indonesia from the days of the archipelago until the Dutch colonial period for three to five centuries. (b) Optimism occurred from 1945 to 1963, using Dichloro Diphenyl Trichloroethane (DDT) insecticide, Ferbam fungicide, and 2,4-D herbicide. The pesticides are used excessively without considering the pest biology. (c) Doubts, starting with the awareness of the negative impact of pesticides on the biotic and abiotic environments. (d) Technology-based of Integrated Pest Management (IPM), a conventional pest control effort that is not successful enough to encourage the emergence of a new paradigm to minimize pesticides. This paradigm is known as IPM technology because its approach is oriented toward pest control technology; and (e) ecology-based IPM is driven by the development and application of IPM based on the understanding of the local ecology of pests and farmer empowerment so that pest control is adapted to the problems that exist in each location (local specific). Farmers are the main determinants and implementers of IPM at the field level [5, 6].

Farmers often make efforts in dealing with pest attacks, and farmers prefer to use synthetic insecticides [7-9]. Farmers in applying insecticides no longer consider the negative impact but prioritize the prevention of greater losses. The average cost incurred by farmers for pesticides in Indonesia is Rp. 370,500 ha/MT or Rp. 1,140,000 ha/MT [10]. The continuous use of insecticides can cause huge losses to the environment, such as the yields and the actors (farmers) in terms of health [11-14].

As stated in Law no. 12 of 1992, pest control concerning the plant cultivation system for pest management, chemical management with pesticides is still allowed but must apply the principle of prudence and wisdom. Plant protection is a process to carry out various efforts to prevent, control, or eradicate plant pests by applying appropriate methods [15]. The dependence of farmers on synthetic insecticides in controlling pest pests has become so widespread and massive. The use of insecticides is a powerful strategy in overcoming pest attacks [4, 9, 16] Based on the results of the study, the behavior of farmers in applying insecticides by farmers tends

to be unwise and not environmentally friendly, the application of insecticides is carried out preventively with the intensity of spraying 2-3 times a week [4, 9].

Referring to Smith's (1983) definition of Integrated pest management (IPM), it can be interpreted that the Integrated Management of Plant Pest Organisms (IMPPO) is a multidisciplinary ecological approach for managing pest populations by utilizing a variety of compatible control tactics in a coordinated management unit [17]. The management system selects, combines, and applies pest control methods based on the calculation and assessment of ecological, economic, and sociological consequences to obtain the best results, namely production stability and minimal losses for humans and the environment [18].

Since 1950, insecticides in protecting shallot plants from pest attacks have shown success. This success has further increased farmers' awareness of using insecticides. It encourages the demand and use of insecticides in the agricultural sector to increase very rapidly. The behavior of farmers in carrying out pest management actions is influenced by the encouragement to maintain the results of the unit area of land, meeting the needs, knowledge, attitudes, and values of the commodities being cultivated. The decision taken by farmers to use synthetic insecticides in dealing with losses due to pest pests is because the positive consequences are much greater than the negative consequences. The use of insecticides in controlling herbivore insect attacks on shallot plants is very familiar to farmers. Lack of concern and lack of knowledge of farmers about the importance of understanding pesticides, causing various problems in their use, use of inappropriate doses, frequency of application more than once a week, will result in have an impact on environmental pollution, farmers' health, the sustainability of beneficial living things. Through the results of this study, we would like to reveal that, although farmers are very familiar with the use of insecticides, but in their application, farmers only use them between 7-40 DAP. With this research, it can be seen the distribution of insecticides used by farmers, so that the government can issue policies on the use of insecticides and their management on local shallots in Palu.

Data regarding the distribution of insecticide use on local shallots in Palu in controlling Liriomyza, sp is needed to support decision making, especially in the use of insecticides on local shallots in Palu. Thus, this research was conducted to reveal the behavior of farmers in the Palu Valley in using insecticides after it was determined that IPM carried out the control, including the distribution and doses of insecticides used in local shallots cultivation in Palu valley.

2. METHOD

2.1 Research sites

This research was conducted from May to July 2021 in five centers of local shallot planting areas in Palu (Maku Village, Wombo Village, Soulove Village, and Bulupountu Jaya Village). The location determination was carried out purposively considering the evaluation of the government's program on IPM policies, and the five areas were Palu local shallot-producing areas in the Palu Valley area.

2.2 Procedures

This study used a descriptive-observational method, which described the condition of farmers in using pesticides on local shallots. Respondents were selected based on their daily activities as local shallot farmers in Palu Valley, Palu, Indonesia. The respondents' determination would be carried out using the Simple Random Sampling method, with the total respondents being 50 farmers (10 farmers of each region), considering that the sample size can represent the existing population. There were primary and secondary data. The primary data was obtained by observation through direct interviews with local hammer shallot farmers using a semi-structured questionnaire to be prepared, and secondary data were obtained through literature studies on various sources related to research issues, including documents/reports of research had been published to support the preparation of research results.

2.3 Data analysis

Quantitative data were analyzed using a simple cross-tabulation analysis which was then interpreted. Meanwhile, the qualitative data was done by interpreting the existing phenomena. The focus of the analysis was the use of insecticides on the Palu local shallot plant.

3. RESULTS & DISCUSSION

3.1 Characteristics of respondents

Sampling was carried out at the Palu local shallot cultivation center in the Palu Valley area on its farming communities (respondents) who use insecticides.

Table 1 shows that 87.5% of the farmers who cultivate shallots in Palu valley were aged >35 years. Generally, respondent farmers with the highest farming experience were at the age of 10-20 years (40%), with the highest level of education was graduating from high school (40%). Respondent farmers who carried out Palu local shallot cultivation activities using synthetic insecticides to control herbivorous insects (pests) were 95%.

3.2 Distribution of the type of insecticide used

Table 2 shows that there are 14 types of trademarks circulating in the Palu valley area and each development location has a characteristic of the insecticide used. There are 3 types of insecticides in Maku area, 6 types of Soulove, 4 types of Bolupontu Jaya, and 1 type of Wombo insecticide. Dependence on chemical pesticides and unlimited use, in fact pesticides have a negative impact on the environment, farmers' health, resistance, resurgence occurs, and the most worrying thing is the killing of natural enemies. This is certainly very dangerous for the balance of the agricultural ecosystem. In addition, the use of chemical pesticides also causes a decrease in environmental quality because it is no longer safe for human health.

Table 1. Characteristics of respondents (shallots farmers) in Palu valley

Characteristic	Category	Number of respondents in each area (n)				Total	%
		Maku	Soulove	Bulupountu Jaya	Wombo		
Age	15-25	-	1	-	-	1	2.5
	25-35	3	0	-	1	4	10.0
	>35	7	9	10	9	35	87.5
	Total	10	10	10	10	40	100
Farming experience	< 10	1	2	-	4	7	17.5
	10-20	4	-	9	3	16	40.0
	21-30	3	6	1	2	12	30.0
	>30	2	2	-	1	5	12.5
	Total	10	10	10	10	40	100
Education level	No schooling	-	-	-	-	-	-
	Primary school	2	6	6	1	15	37.5
	Junior high school	3	-	2	3	8	20.5
	Senior high school	4	4	2	6	16	40.5
	Bachelor / D3	1		-	-	1	2.5
	Total	10	10	10	10	40	100
Farming with insecticides	Yes	10	10	8	10	38	95.0
	No	0	0	2	-	2	5.0
	Total	10	10	10	10	40	100

Table 2. Distribution of insecticides types used by village

Village	Insecticides types (Active ingredients)	Application dosage	Application schedule
Maku	Spinoteram (spineteram): 120 g/l	0.5 ml/14 l	Twice a week
	Klorfenapir (chlorfenapyr): 320 g/l	0.5 ml/14 l	Twice a week
	Fipronil 0.3%	0.5 ml/14 tank	Three times a week
Soulove	Abamektin 18 g/l	15 ml/tank	Twice a week
	Atamon	15 ml/tank	Twice a week
	Alfa Sipermetrin 50 g/l	10 ml/tank	Twice a week
	Sipermetrin 60 g/l	10 ml/tank	Twice a week
	Klorantraniliprol 50 g/l	15 ml/tank	Twice a week
	Abamektin 18 g/l	15 ml/tank	Twice a week
Bulupountu Jaya	Karbosulfan 200.11 g/l	20 ml/tank	Once a week
	Lamda Sihalotrin 25 g/l	10 ml/tank	Once a week
	Abamektin: 60 g/l	10 ml/tank	Once a week
	Klorantraniliprol 50 g/l	10 ml/tank	Once a week
Wombo	Lamda Sihalotrin 25 g/l	10-40 ml/tank	1-3 times a month

Table 2 shows that each type of insecticide application was carried out 1-3 times per week, with the measurement of the application dose varying greatly by using a more implementable bottle cap method (1 bottle cap is equivalent to 10 ml).

3.3 Time to use insecticide

It was revealed that insecticides usage on local shallots in the five planting areas was mainly carried out in the morning (78.98%) and 21,39% in the afternoon and evening (Table 3).

3.4 Application dosage

Based on the study results (Table 4), information was obtained that the number of local Palu shallot farmers who used insecticides according to the application dose was 63.15%, and 36.85% did not.

Table 3. Time table of insecticide usage

Pesticide usage time	Area/Location (Village)				Total	%
	Maku	Soulove	Bulupountu Jaya	Wombo		
Morning	6	9	5	10	30	78.98
Afternoon	-	1	2	-	3	7.89
Evening	4	-	1	-	5	13.15
Total	10	10	8	10	38	100

Table 4. Number of Respondents who use appropriate and inappropriate insecticides dosage

Dosage suitability to the product usage recommendation	Area/location (Village)				Total	%
	Maku	Soulove	Bulupountu Jaya	Wombo		
Suitable (n)	10	2	4	8	24	63.15
Not suitable (n)	-	8	4	2	14	36.85
Total	10	10	8	10	38	100%

Table 5. Frequency of insecticide use in one growing season

Frequency Insecticide Usage (usage prescribed recommendation)	Area/location (Village)				Total	%
	Maku	Soulove	Bulupountu Jaya	Wombo		
Without any usage prescribed recommendations	-	-	5	2	7	8.0
1-3 times a week	10	10	1	6	27	17.5
> 3 times a week	-	-	2	2	4	67.5
Not Using (Organic)	-	-	2	-	2	10.0
Total	10	10	10	10	40	100

Table 6. External factors in insecticide use

External factor	Category	Area/location (Village)				Total	%
		Maku	Soulove	Bulupountu Jaya	Wombo		
Agricultural counseling	1-4 times per year	-	7	-	6	13	32.5
	5-8 times per year	-	1	-	2	3	7.5
	9-12 times per year	10	-	10	-	20	50.0
	Never	-	2	-	2	4	10.0
	Total	10	10	10	10	40	100
Field school for plant pest management	Yes (1-2 Times)	10		7	-	17	42.5
	No	-	10	3	10	23	47.5
	Total	10	10	10	10	40	100

3.5 Frequency of pesticide use

Information was obtained that insecticides usage in the Palu Valley area was 67.5% with a frequency of 1-3 times a week, and 8,0% were applied without heeding the prescribed usage recommendations (Table 5).

3.6 External factors in the use of insecticides

Table 6 shows that insecticides at the farm level were also influenced by external factors, especially agricultural extension activities and Field Schools. In Maku Village, the number of respondents who took part in counseling and had attended field school was 100% compared to Guntarano Village (47.5% had never attended field school with a shallow level of involvement in extension activities, 1-4 times by 32.5%).

It was revealed that farmers in the Palu Valley area who cultivate the local shallot commodity in Palu were very familiar with insecticides; about 95% of respondents used insecticides. The high use of insecticides was caused by attacks by plant-disturbing organisms, mainly herbivorous insects (pests) that attack onion plants. Farmers perceive pest and disease attacks as the leading cause of crop failure; meanwhile, farmers' perception of the most effective pest control technique is the use of chemicals [19].

The results obtained information that the reasons that encourage farmers to apply insecticides with a calendar system will prevent plants from pest attacks, plants become fertile, and crop yields increase, especially the concept of Integrated Pest Management (IPM). Farmers' perceptions of insecticides as a solution to problems due to pest attacks without regard to economic and ecological aspects will encourage excessive use of pesticides [20]. Insecticides do not increase yields but maintain the results obtained per unit area of land [21].

We found out that 16 insecticides trade names spread over 4 areas. The large number of insecticides circulating shows that farmers are very familiar with these chemicals in carrying out their activities as shallot farmers without considering the impact or risk it causes. Several risks can occur with chemicals, such as risks for user safety, consumers, and the environment [22]. Spraying pesticides that do not meet the rules would result in many impacts, including health impacts for humans, namely poisoning in farmers [23]. Farmers' families are at risk of pesticide poisoning because they are always in contact with spraying farmers, pesticide storage places, and pesticide application equipment, which can cause contamination of water, food, and equipment at home. Poisoning occurs due to a lack of understanding of the farmer's family about the dangers of pesticides; there are still many farmers who use pesticides who do not pay attention and follow good and safe handling methods, so it can be harmful to farming families [1, 24, 25]. Pest control should be carried out in an environmentally friendly, practical, and effective. However, besides synthetic insecticides, there are no available other insecticides, so farmers' choice falls on the synthetic ones.

The application of insecticides was 1-3 times of spraying every week (67.5% of shallot farmers), and the rest 17.5% were uncertain in the application. Several reports that the intensity of insecticide use is 2-3 times [2, 8, 26]. The high insecticides usage was allegedly caused by the high attack of herbivorous insects on the local Palu shallot plant.

Based on our results, about 60% of respondents applied insecticides according to the usage dose recommendation, namely, the use of measuring devices (bottle caps) was under the recommendations, as stated on the packaging label. However, it most likely does not follow the prescribed recommendation dosage and concentration. The main reason put forward by respondent farmers in applying insecticides according to the recommended dosage is to save the use of insecticides, avoid the danger of poisoning, and reduce residue levels in onion bulbs. Insecticide application should refer to the application dose specified by the manufacturer to avoid some adverse effects in the application [27, 28]. Although farmers knew about the dosage, the results showed that it did not comply with what was recommended on the packaging label because it was difficult to overcome when an attack occurred.

Farmers' decisions to use insecticides to control local shallot pests are less influenced by external factors, mainly from monthly extension activities and Integrated Pest Management Field Schools (in Indonesia: Sekolah Lapang Pengendalian Hama Terpadu, abbreviated as SLPHT) conducted 1-2 times a year. Following our study, information was obtained that the lack of involvement of some respondents in extension activities was caused by the minimal area of land acquired and

having to look for other jobs. The lack of participation in extension activities held by the group due to other activities (masons) causes farmers' understanding of the adverse effect, and the advantages of insecticides are minimal. Then, it has implications for the farmer's tendency to use insecticides to maintain yields. For this reason, in maximizing the information obtained by respondent farmers, it is necessary to reform the institutional system at the farmer level so that each training activity is the chairman who often participates, and group members take turns as participants in the activity. In efforts to suppress the culture of excessive practice in insecticides, it is necessary to raise awareness and increase knowledge about insecticides so that their implementation can be reduced. Availability of information materials for further research and the basis for the government to make policies on the use of insecticides.

4. CONCLUSIONS

Farmer's activity in the local shallot cultivation was inseparable from the use of insecticides in controlling herbivorous insects (95% farmers). Insecticides usage in the Palu Valley area was 67.5% with a frequency of 1-3 times a week, and 17.5% were applied without heeding the prescribed usage recommendations. There were 16 types of insecticide trademarks circulating in Palu valley, including 3 types in the Maku area, 6 types in Soulove, 4 types in Bolupontu Jaya, and 1 type in Wombo. Insecticide application was mostly in the morning (60-100%), 1-3 times a week (67.5%), and without rules of use by 17.5%. It is necessary to conduct further research related to the health of farmers who apply insecticides using previous data to find out more about insecticides in the Palu local shallot cultivation in the Palu valley.

Further research is needed to see the impact of using insecticides on the environment (degradation of land quality, pesticide residues) and on the health of farmers and identify the composition of pesticides that do not contain carcinogens.

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