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FARMERS' KNOWLEDGE AND EFFECTIVENESS OF INSECTICIDE USES BY FARMERS IN CONTROLLING *Spodoptera exigua* ON SHALLOTS IN BREBES AND CIREBON[1)]

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ABSTRACT

Objective of the research was to identify the knowledge and effectiveness of the use of insecticides by farmers in the control of Spodoptera exigua *caterpillar on shallots. The study was conducted in November 2005 using a survey method in Losari and Pabedilan Districts of Cirebon Regency, West Java and Wanasari District of Brebes Regency, Central Java. Data were collected through group discussions and individual interviews using a questionnaire. Total number of respondents was 100 farmers. The collected data were analyzed using the descriptive statistical method. The results showed that the major shallot pests in Brebes and Cirebon areas were* S. exigua, S. mauritia, *and* Liriomyza *spp. Farmers in the Cirebon area had limited knowledge and resources to select effective insecticides for controlling* S. exigua. *They sprayed their crops routinely with insecticides at concentrations of 150-200% higher than the recommended rates and at very short intervals, 1-2 days. There were also strong indications that the intensive use of insecticides by farmers was triggered by the low effectiveness of the insecticides used.* S. exigua *in Brebes was predicted to have been resistant to 3 of 7 insecticides used by farmers (48%), whereas in Cirebon the pest has been resistant to 5 of 8 insecticides used by farmers (63%). Most farmers used mixed insecticides to control* S. exigua. *In Brebes, among the 17 farmers who used a mixture of two insecticides, 8 of them (47%) used a mixture of synergistic insecticides, two others (12%) used mixtures of two antagonistic insecticides, while the rest was unknown. In Cirebon, among 18 farmers who used a mixture of two insecticides, 6 farmers (33%) used a mixture of two synergistic insecticides, 5 farmers (28%) used a mixture of two antagonistic insecticides, while the rest is unknown. The use of insecticides by 54% farmers in Brebes and 74% farmers in Cirebon to control* S. exigua *were not effective, with an average of crop damages of more than 10%. The control technology components required by farmers, which is in accordance with the farmers' conditions are techniques to select effective insecticides and to mix synergistic insecticides.*

[**Keywords:** *Allium ascalonicum*, shallot, *Spodoptera exigua*, *Spodoptera mauritia,* pest control, insecticide, Brebes, Cirebon]

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INTRODUCTION

One of the major problems faced by farmers in efforts to increase shallot production in lowland is the high crops damage caused by onion caterpillar *Spodoptera exigua* Hubn. According to Dibiyantoro (1990), yield losses due to the pest ranged from 45% to 57%. In addressing the problem, farmers generally use insecticides intensively, either a single or mixed insecticides, at high dose and scheduled spraying at a short interval of 2-3 days (Koster 1990; Buurma and Nurmalinda 1994). These intensive uses of insecticides are irrational, inefficient, and potentially cause negative impacts to the environment and enhance pest resistance to the insecticides (Moekasan *et al*. 1999; Sastrosiswoyo and Rubiati 2001).

To improve farmers' attitude in using the insecticides to control *S. exigua*, a control technique based on a control threshold has been developed and introduced to farmers. The technique was proven effective and reduced the use of insecticides to 60% (Moekasan *et al*. 2004). Farmers' adoption of this control technique, however, was very low. Farmers still use the old way of controlling the pest using a single or mixed insecticides at high dosages and scheduled spraying at an interval of 2 days (Basuki *et al.* 2002; Moekasan and Basuki 2007). This shows that the solutions offered by researchers are not appropriate to the needs of farmers.

The intensive use of insecticides by farmers is not an irrational action. There are several possibilities that cause it, such as limited knowledge of farmers, lack of information available, and too many kind of insecticides in the market that cause farmers choose and use the wrong type of insecticide, which is less effective or has decreased its efficacy for controlling *S. exigua.* The less effective insecticides are because the type of insecticides might not be recommended for controlling *S. exigua* or the pest has become resistant to the insecticides. Consequently, to improve effectiveness of the insecticides, farmers increased the dosages of the insecticides and shortened the spraying interval.

The study aimed to identify farmers' knowledge and effectiveness of insecticides used by farmers in controlling *S. exigua* caterpillar. The information resulted is expected to be the basis for developing pest control techniques for *S. exigua* using insecticides that are better appropriate to the needs of farmers, thus potentially be adopted by them.

MATERIALS AND METHODS

The research sites were purposely selected based on the consideration that the locations were the major shallot production centers in the lowlands. Based on these criteria, Brebes and Cirebon areas were selected. The same criteria were used to select units of smaller research sites, i.e. Klampok Village (Wanasari District, Brebes Regency) and Kalirahayu Village (Losari District) and Pabedilan Kaler Village (Pabedilan District), Cirebon Regency.

Targets of the population study were farmers who grew shallots in the dry season continuously from year to year. Based on these criteria, 100 farmers as the respondents were randomly selected, consisting of 50 farmers from Klampok Village, 25 farmers from Kalirahayu Village, and 25 farmers from Pabedilan Kaler Village.

The study was conducted through pre-survey and formal survey stages. The pre-survey included sites and respondent selections, secondary data collection, and group discussions. Through the group discussion technique (Nurmalinda *et al.* 1992) data collected were qualitative information on knowledge, reason and action of farmers in controlling *S. exigua* using insecticides, especially the way of spraying, the selection of pesticide type, as well as concentration and determination of insecticide formulations used. Information obtained from the pre-survey was used as a reference to compile a list of questions or a formal survey questionnaire.

In the formal survey, data were collected through individual interviews using a questionnaire containing questions in the form of closed questions (multiple choices), questions with open-ended answers, and a combination of open and closed questions. In particular, photographs were included in the list of questions to enable farmers identify the major pests of shallots that become their main problem. The photographs were just labeled pests A to E, respectively (Figure 1). Code A was the onion caterpillar (*S. exigua*), B for the rice armyworm (*S. mauritia*), C the armyworm (*S. litura*), D for mole cricket (*Gryllotalpa* spp.), and E for *Liriomyza* spp. If the respondents mentioned pests that were not in the available pictures, recordings were then made.

In the formal survey, data collected were (a) characteristics of farmers; (b) identification of major pests by farmers; (c) farmers' knowledge in assessing the effectiveness of insecticides; (d) type and concentration of insecticide formulations used either single or mixed; (e) sources of farmers' knowledge in choosing an effective insecticide used; (f) intervals of spraying; and (g) farmers' estimates on percentage of crop damage by the pest. To assist farmers in estimating the percentage of crop damage by the pest, units of measure that is easily understood by farmers were used at the time of interview, namely half for 50%, a quarter for 25%, a one-tenth for 10%, one-twentieth for 5%, as well as other guidelines, such as under one-tenth, less than a quarter, and more than one-tenth.

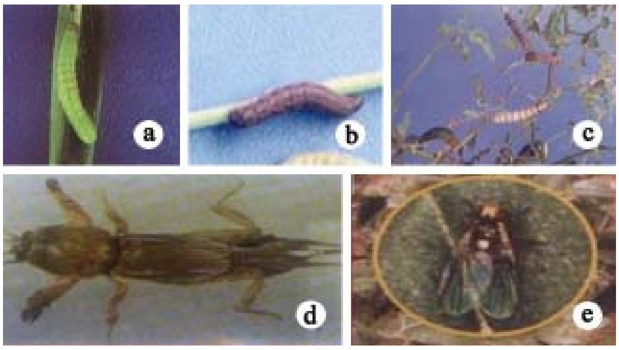

Figure 1. Pictures of pests of shallots shown to farmers during interview for identifying the main pest of shallots; (a) onion caterpillar (*Spodoptera exigua*), (b) rice army-worm (*Spodoptera mauritia*), (c) armyworm (*Spodoptera litura*), (d) mole cricket (*Gryllotalpa* spp.), and (e) *Liriomyza* spp.

Data collected from the closed questions were analyzed using the descriptive statistics, while data from the open questions were processed using the content analysis (Adiyoga and Soetiarso 1999; Ameriana *et al.* 2000; Adiyoga *et al.* 2001).

RESULTS AND DISCUSSION

Identity of Respondents

Most of respondents in Brebes (60%) were tenant farmers with land areas of <0.2 ha (74%), formal elementary education (78%), and shallot farming experience >10 years (78%). Respondents in Cirebon were mostly tenant farmers (82%), with a cultivation area of <0.3 ha (50%), formally graduating from elementary school (74%), and shallot farming experience of >10 years (62%) (Table 1).

Formal education of respondents in Cirebon and Brebes were elementary school graduates. According to Rogers (1962) *in* Adiyoga *et al.* (1999), the higher the farmers' education the sooner they accept innovation. In other words, formal educations of the respondents were low,

Table 1. Characteristics of shallot farmers in Brebes and Cirebon, 2005

Farmers' characteristics	Brebes (n = 50)		Cirebon (n = 50)	
	Number	%	Number	%
Formal education				
Not graduated from elementary school	2	4	0	0
Elementary school graduate	39	78	37	74
Junior high school graduate	4	8	7	14
Senior high school graduate	5	10	5	10
University	0	0	1	2
Experiences in shallot farming (years)				
<5	2	4	6	12
5-10	9	18	13	26
11-15	14	28	8	16
16-20	12	24	9	18
>20	13	26	14	28
Farmers' status				
Owner	2	4	2	4
Rental	30	60	41	82
Owner and rental	12	24	7	14
Share cropper	6	12	0	0
Farm size (ha)				
<0.10	3	6	0	0
0.10-0.20	34	68	8	16
0.21-0.30	0	0	17	34
0.31-0.40	9	18	9	18
0.41-0.50	0	0	9	18
>0.50	4	8	7	14

n = number of respondents

indicating that they were categorized slow in receiving innovation. However, with the long experience of farming (>10 years), capability of the farmers in shallot cultivation was quite high. This may be able to cover their shortfall due to the low formal education.

Most of the respondents owned land of <0.3 ha, indicating that most respondents were small farmers. However, according to Adiyoga *et al.* (1999), the narrow cultivation area does not mean that the farmers were slow in accepting a new technology.

Major Shallot Pests According to Farmers' Perceptions

A major pest is a pest that always exists throughout the season and the damage caused is the highest among the existing pests, while a potential pest does not always present but comes regularly and can explode at any time. Based on such understanding, the major pest of shallot mostly found by farmers in Brebes and Cirebon was *S. exigua,* whereas the potential pest that rarely attacks but if its attack is difficult to control was *S. mauritia*. The other pest categorized as a minor was leaf cutter, *Liriomyza* spp. (Table 2).

The farmers' perceptions indicated that *S. mauritia* was a potential pest on shallot. Based on the results of previous research or monitoring, no one has mentioned that *S. mauritia* was a potential pest of shallot. It should be noted that the pest identification by farmers was based on photographs shown in the questionnaire. If the information given by the farmers was true, then research on *S. mauritia* needs to be more intensified in the future, since currently the pest-control study was focused on *S. exigua.*

Pesticide Formulations to Control Onion Caterpillar Based on Farmers' Knowledge

According to the official government list, as compiled by the Directorate of Fertilizer and Pesticides, there were 73 pesticides to control *S. exigua* (Ditjen BSP 2004), but not all of the pesticides were known by farmers. Farmers in Brebes mentioned that the number of appropriate pesticides used to control onion caterpillar was 58 pesticides. From that number, only 20 pesticides (40%) met the official government list, the remaining 38 pesticides (60%) were not in accordance with the official government list (Appendix 1). Among the 58 formulations, only 14 pesticides were widely known by farmers, however, those in accordance with the official government list were only 9 pesticides that are to control *S. exigua* (64%) (Table 3).

Farmers in Cirebon mentioned that there were 63 pesticides that can be used to control onion caterpillar, but according to the official government list only 18 (29%). The remaining 45 pesticides (60%) were not in accordance with the official government list (Appendix 2). Among the 63 formulations, there were 11 pesticides to control *S. exigua* that are widely known by farmers, although according to the official government list only 8 pesticides (64%) (Table 3). If it is assumed that the pesticides suitable for controlling *S. exigua* are in accordance with the registered pesticides, hence it can be said that there is limited knowledge of farmers in recognizing the appropriate pesticides to control *S. exigua.*

Sources of Farmers' Information in Selecting Insecticides for Onion Caterpillar

In choosing the effective insecticides for onion caterpillar, sources of information used by farmers in Brebes and Cirebon were relatively the same, namely (1) their own observations on efficacy of insecticides used by other farmers, and (2) told by the waiters or owners of the pesticide store. The role of leading farmers as sources of knowledge was quite important in Brebes, although it was less important in Cirebon. Other sources of knowledge were promotion by pesticide companies, recommendations from agricultural extension officers or from formulators of pesticide companies, as well as the demonstration plots, however, they were in fact not primary sources of information (Table 4).

Table 2. Farmers' perception on the main pests of shallots in Brebes and Cirebon, 2005

Pest	The most frequent to attack (frequency)		The most damaging (frequency)		The most difficult to control (frequency)	
	Brebes	Cirebon	Brebes	Cirebon	Brebes	Cirebon
Spodoptera exigua	24	27	10	22	8	21
S. mauritia	22	19	31	20	26	20
S. litura	2	0	1	0	1	0
Mole cricket	0	3	4	2	2	1
Liriomyza spp.	2	1	4	5	7	3
No response	0	0	0	1	6	5
Total	50	50	50	50	50	50

Table 3. Commercial names of pesticide formulations to control *Spodoptera exigua* on shallots according to farmers in Brebes and Cirebon, 2005

Commercial name	Formulation status		Number of farmers (n = 50)		%	
	Brebes	Cirebon	Brebes	Cirebon	Brebes	Cirebon
Agrimec	0		17		34	
Buldok	1	1	15	37	30	74
Curacron	1	1	14	25	28	50
Decis	0	0	15	23	30	46
Dursban	1	1	50	48	100	96
Hostathion	1	1	38	45	76	90
Lannate	1		21		42	
Larvin	1		18		36	
Matador		1		10		20
Metindo	1	1	39	19	78	38
Proclaim	1	1	10	19	20	38
Prodigy	0		22		44	
Prothol		0		15		30
Rizotin	0		11		22	
Traser	1	1	50	40	100	80
Trigard	0	0	11	10	22	20

Formulation status
1 = formally registered for *S. exigua*
0 = not registered for *S. exigua*

Table 4. Sources of information used by farmers in Brebes and Cirebon to select effective insecticides for *Spodoptera exigua*, 2005

Source of information	Brebes (n = 50)		Cirebon (n = 50)	
	n	%	n	%
Observing the effectiveness of the insecticides used by other farmers	48	96	46	92
Recommendation from key farmers	8	16	2	4
Recommended by pesticide keeper store	8	16	10	20
Promotion event of pesticides company	1	2	0	0
Recommended by extension officers	1	2	1	2
Recommendation from pesticides company agents	0	0	1	2
Observing on the insecticide demplots	1	2	2	4

Most of farmers of Brebes (96%) and Cirebon (92%) stated that self observations on efficacy of insecticides used by other farmers were the most important source of information. According to farmers, if an insecticide was proven effective by other farmers, it was also expected to be effective if used by the farmers themselves. In terms of dissemination of innovation, it seems that onion caterpillar control techniques using insecticides will spread faster and be adopted by farmers if farmers were actively involved in the dissemination process. The results showed that the role of government, in this case the agricultural extension officers as sources of information for farmers in choosing the appropriate insecticides still needs to be improved.

Table 5. Farmers' knowledge on the pesticide effectiveness indicators against *Spodoptera exigua* in Brebes and Cirebon, 2005

Indicators	Brebes (n = 50)		Cirebon (n = 50)	
	n	%	n	%
The caterpillar is dead	22	44	22	44
The caterpillar does not want to eat	33	66	14	28
Plant damage due to the caterpillar number does not increase	25	50	33	66
The egg of caterpillar does not hatch	2	4	20	40
The caterpillar becomes yellow	6	12	2	4
The caterpillar dead after 5 days	1	2	0	0

Farmers could give more than one answer.

Farmers' Knowledge on Evaluation of Pesticide Efficacy to Control Onion Caterpillar

Knowledge of farmers in Brebes and Cirebon in evaluating the efficacy of pesticides used to control onion caterpillar were relatively similar. All farmers used at least the same indicators to determine the efficacy of insecticides, i.e. (1) the caterpillars die; (2) the caterpillars do not want to eat; (3) crop damages due to the caterpillar do not increased; (4) eggs of the pest do not hatch; (5) color of the caterpillar turns into yellow; and (6) the caterpillars die 5 days later (Table 5). Farmers considered an insecticide not effective if the day after spraying did not show any one of the efficacy indicators. The eggs that did not hatch became an indicator that farmers in Cirebon paid more attention (40%) than those in Brebes (4%).

Based on the efficacy indicators, farmers made decisions on the insecticides used, spraying frequency, dosage or concentration, insecticide mixing, and replacing the insectiside used with other brand if it is considered less effective. A reason that farmers sprayed their crops with insecticides was just as their habit to imitate or to follow other farmers (Soetiarso *et al.* 1999) seems inappropriate in this study.

Farmers' knowledge on efficacy indicators of the insecticides is very important to note by the researchers in developing techniques to control *S. exigua*. A new technology to control *S. exigua* that does not show effectiveness in accordance with farmers' perceptions would be difficult to be adopted by the farmers.

Farmer's Actions to Control Onion Caterpillar Using Insecticides

Routine and conditional insecticide spraying

The insecticide spraying practiced by farmers can be classified into two categories, i.e. regular spraying with a fixed time interval, and conditional spraying with no fixed time interval, dependent on the pest conditions. In Brebes, the percentages of farmers that practiced regular and conditional spraying were 56% and 44%, respectively, whereas in Cirebon, they were 46 % and 54%, respectively. The spraying interval used by most of farmers in Brebes and Cirebon that routinely sprayed their crops was 3 days. The spraying interval used by most of farmers that sprayed their crops conditionally was also 3 days on the light pest attacks and it was increased to 2 days or even every day during the severe attacks (Table 6). Results of the study indicated that short intervals of insecticide spraying (1-2 days) were done when the onion caterpillar became more severe and the farmers could no longer controlled the pest by spraying with less frequent intervals (3-4 days).

Table 6. Methods and frequency of insecticide spraying applied by farmers in Brebes and Cirebon to control *Spodoptera exigua*, 2005

Method and frequency of spraying	Brebes		Cirebon	
	n = 50	%	n = 50	%
Spraying methods				
Routine	28	56	23	46
Conditional	22	44	27	54
Frequency of spraying				
Routine	28	100	23	100
Once in 2 days	8	29	3	13
Once in 3 days	20	71	17	74
Once in 4 days	0	0	3	13
Conditional	22	100	27	100
Light attact				
Once in 2 days	2	9	2	7
Once in 3 days	15	68	14	52
Once in 4 days	2	9	8	30
Once in 5 days	2	9	2	7
Once in a week	1	5	1	4
Severe attack				
Every day	5	23	3	11
Once in 2 days	14	64	19	70
Once in 3 days	2	9	5	19
Once in 4 days	1	5	0	0

Control of onion caterpillar for the first time and during the plant growth

Control of onion caterpillar was first performed by farmers when eggs of the pest were visible on their crops or when the crop damage was still low. The control was generally started at 10-15 days after transplanting (DAT). When the pest infestation was severe enough, farmers performed a mechanical control by picking up the caterpillars and the eggs by hand from the leaves. During the plant growth, most farmers controlled the pest by combining both mechanical control and insecticides. If the pest attacks became more severe during the plant growth, then most farmers increased concentrations of the pesticide used to 150-200% of the recommended ones.

Results of the study indicated that the reasons of farmers practiced either regular or conditional insecticide spraying at high dosages and short intervals were in order their crops not being attacked by the pests, as found on bell pepper and chili farmers (Adiyoga *et al.* 1999, 2007). Farmers' actions to increase insecticide concentrations up to 150-200% of the recommended dosages and the spraying

Table 7. Control measures for *Spodoptera exigua* carried out by farmers in Brebes and Cirebon, 2005

Control measure	Brebes (n = 50)		Cirebon (n = 50)	
	Routine (n = 28) %	Conditional (n = 22) %	Routine (n = 23) %	Conditional (n = 27) %
The first time of controlling *S. exigua* (DAP)				
5	0	5	9	0
7-8	21	18	13	15
10-15	79	77	78	67
18-25	0	0	0	19
Control measure for the first time				
Using insecticides	68	55	65	81
Picking the eggs and larvae by hand	32	45	35	19
Control measure during the growing period				
Using insecticides only	14	0	4	0
Insecticides and mechanical	86	100	96	100
Concentration of insecticides				
100% as recommendation	39	27	39	26
125% of recommendation at severe attack	4	0	0	0
150% of recommendation at severe attack	14	41	22	33
200% of recommendation at severe attack	43	32	39	41
The last spraying (DBH)				
1-5	71	73	43	44
6-10	29	9	52	52
> 10	0	18	4	4

Routine = farmers who spraying insecticides in routine basis, Conditional = farmers who spraying insecticides in conditional basis, DAP = days after planting, DBH = days before harvesting intervals (1-2 days), implicitly suggests that the onion caterpillar was uncontrollable in the normal manner, i.e. using the recommended insecticide concentrations and spraying intervals of less than 3-4 days. This could be the pests had been resistant to the insecticides used.

The final insecticide spraying done by farmers in Brebes was later than that in Cirebon. More than 70% of farmers in Brebes and approximately 40% in Cirebon stopped spraying their crops 1-5 days before harvest. So far, there has been no report on pesticide residues found in the onions produced using such insecticide treatments.

Types and Efficacy of Insecticides Used by Farmers

Insecticides used

Most of the insecticides used to control the onion caterpillar by farmers in Brebes and Cirebon were mixtures of 2-6 insecticides (Table 8). The most widely used insecticides singly or in a mixture by farmers in Brebes were Traser, Dursban, Hostathion, Metindo, Prodigy, Trigard, and Agrimec. Three of the seven insecticides (48%), i.e. Dursban, Trigard, and Agrimec were allegedly ineffective because, according to Moekasan and Basuki (2007), the population of *S. exigua* in Brebes had been resistant to these insecticides. In Cirebon there were eight most widely used insecticides by the farmers, i.e. Dursban, Traser, Buldok, Hostathion, Metindo, Decis, Trigard, and Tokuthion. Among them, five insecticides (63%) thought to be ineffective, because according to Moekasan and Basuki (2007), the population of *S. exigua* in Cirebon had been resistant to these insecticides (Table 9).

Results of the study showed that many ineffective insecticides were still used by farmers in Brebes and Cirebon to control *S. exigua*. Ineffectiveness of the insecticides probably had lead the farmers to spray their crops with high dosages and short spraying intervals to improve their effectiveness.

Table 8. Type of pesticides used by farmers in Brebes and Cirebon to control *Spodoptera exigua*, 2005

Pesticides mixture	Brebes (n = 50)		Cirebon (n = 50)	
	n	%	n	%
Single insecticide	6	12	15	30
Two types of insecticides	17	34	18	36
Three types of insecticides	15	30	13	26
Four types of insecticides	7	14	3	6
Five types of insecticides	3	6	0	0
Six types of insecticides	2	4	1	2

Table 9. Type of pesticides used by farmers in Brebes and Cirebon to control *Spodoptera exigua*, 2005

Commercial name	Percentage of farmers who used insecticides	
	Brebes (n = 50)	Cirebon (n = 50)
Agrimec	16	0
Buldok	0	18
Decis	0	8
Dursban	57	50
Hostathion	36	24
Metindo	24	10
Prodigy	22	0
Tokuthion	0	8
Traser	82	52
Trigard	16	13

Insecticides mixture used by farmers

The mixed insecticides used by farmers may cause synergistic, antagonistic, or neutral effects to the pest. According to Benz (1971) *in* Moekasan (2004), if a chemical compound of an insecticide had the ability to increase toxicity of the insecticide, it is called has a synergistic effect. Conversely, if the compound reduces toxicity of the insecticide, it is then called has an antagonistic effect, and if the compound has no effect on toxicity of the insecticide, it is called has a neutral effect. Moekasan *et al.* (2006) who examined the effects of a mixture of two types of insecticides in the laboratory, reported that from 17 farmers in Brebes that used a mixture of two insecticides, 8 farmers (47%) used a mixture with a synergistic effect, 2 farmers (12%) used a mixture with an antagonistic effect, and 7 farmers (41%) used a mixture with unknown effect. In Cirebon, 6 of 18 farmers (33%) used a mixture of two insecticides which has a synergistic effect, 5 farmers (28%) used a mixture with antagonistic effect, and 7 farmers (41%) used a mixture with unknown effect (Table 10). Efficacy of mixtures of three or more insecticides could not be evaluated, since there has been no research on this aspect.

Effectiveness of insecticide used by farmers

Moekasan and Basuki (2007) stated that an insecticide to control onion caterpillar was effective if the leaf damages by the pest were still below the control threshold (5%). Based on this category, it can be said that the use of insecticides by most of farmers in Brebes (54%) and Cirebon (74%) was not effective because the levels of crop damage were >10% (Table 11). Table 11 also shows that the use of insecticides by farmers in Brebes was more effective than that in Cirebon. In Brebes, the percentage of farmers, which their crops damaged by the onion caterpillar

Table 10. Effect of insecticide mixture used by farmers in Brebes and Cirebon to control onion caterpillars, 2005

Insecticide formulation	Effect of insecticide mixture					
	Brebes (n = 17)			Cirebon (n = 18)		
	Antagonistics	Synergistics	Unknown	Antagonistics	Synergistics	Unknown
Dursban + Traser	0	7	0	0	5	0
Metindo + Traser	0	0	0	0	1	0
Buldok + Traser	0	0	0	1	0	0
Buldok + Trigard	0	0	0	1	0	0
Dursban + Hostathion	0	0	0	3	0	0
Agrimec + Traser	0	1	0	0	0	0
Prodigy + Traser	0	0	3	0	0	0
Hostathion + Traser	2	0	0	0	0	0
Hostathion + Rampage	0	0	1	0	0	0
Dursban + Rizotin	0	0	1	0	0	0
Dursban + Prodigy	0	0	2	0	0	0
Ammate + Decis	0	0	0	0	0	1
Atabron + Tokution	0	0	0	0	0	1
Dursban + Furadan	0	0	0	0	0	1
Dursban + Decis	0	0	0	0	0	1
Dursban + Indobas	0	0	0	0	0	1
Dursban + Baycarb	0	0	0	0	0	1
Rampage + Ripcord	0	0	0	0	0	1
Total	2(12%)	8(47%)	7(41%)	5(28%)	6(33%)	7(41%)

Table 11. Plant damages by *Spodoptera exigua* estimated by farmers in Brebes and Cirebon, 2005

Level of plant damages	Percentage of farmers	
	Brebes (n=50)	Cirebon (n=50)
	...................%	....
0-5	46	26
10-15	30	36
20-25	22	22
>30	2	16

between 0-5% was 46%, while in Cirebon was only 26% (Table 11). This may be due to two reason (1) onion caterpillar in Cirebon was resistant to more insecticides used than that in Brebes, and (2) the number of farmers in Cirebon that used insecticide mixture that have antagonistic effects was more than those in Brebes (Table 9 and 10).

CONCLUSION

The main pest becoming a problem for shallot farmers in Brebes and Cirebon was the onion caterpillar, *Spodoptera exigua*, whereas the potential pest was *S. mauritia*, and the less important pest was *Liriomyza* spp. Farmers in Brebes and Cirebon had limited knowledge on selection of the appropriate insecticides to control the onion caterpillar. The main sources of information used by farmers in Brebes and Cirebon to select effective insecticides were fellow farmers and waiters or owners of pesticide stores.

The main indicators used by farmers to assess effectiveness of an insecticide for *S. exigua* were (1) the caterpillars die; (2) the caterpillars do not want to eat; (3) the crop damages due to the caterpillars do not increased; and (4) eggs of the pest do not hatch. Intensive use of insecticides by spraying at a regular basis using a high concentration of formulations, i.e. 150-200% of the recommended concentration and a short 1-2 day spraying interval were practiced by farmers in Brebes and Cirebon to control *S. exigua*. The insecticide use practiced by most farmers in Brebes and Cirebon was less effective because the pests, particularly *S. exigua* has been resistant to some of the insecticides used by farmers and the insecticides used were a mixture of two or more antagonistic insecticides.

Further research needs to be done to reconfirm the status of *S. mauritia* as a potential pest of onion. A system for providing information to farmers on effective insecticides to control *S. exigua* need to be developed. Research on control components of *S. exigua* that fit the needs of shallot farmers are (1) selection of effective insecticides to *S. exigua*; (2) selection of insecticides that prevent the *S. exigua* eggs to hatch; and (3) studies to obtain insecticide mixtures of 2-3 insecticides that have synergistic effects.

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Appendix 1. Commercial names of pesticide formulations to control *Spodoptera exigua* on shallot according to farmers in Brebes, 2005

Commercial name	Formulation status	Number of farmers (n =50)	%
Agrimec	0	17	34
Akodan	0	1	2
Ammate	1	3	6
Amistar	0	1	2
Atabron	1	3	6
Azodrin	0	1	2
Basban	0	4	8
Baycarb	0	3	6
Bayrusil	0	1	2
Bestan	0	1	2
Bestox	0	1	2
Buldok	1	15	30
Callicron	0	5	10
Cascade	0	6	12
Cirodex	0	1	2
Cober	0	1	2
Cobra	0	1	2
Curacron	1	14	28
Darmasan	1	1	2
Decis	0	15	30
Diazinon	0	1	2
Dursban	1	50	100
Hopsin	0	2	4
Hostathion	1	38	76
Indobas	0	3	6
Kilat	0	2	4
Kwikuang	0	1	2
Lannate	1	21	42
Larvin	1	18	36
Marshal	1	3	6
Matador	1	3	6
Metindo	1	39	78
Metonik	0	1	2
Micindo	0	1	2
Misotin	0	4	8
Nomolt	0	1	2
Orthene	0	1	2
Padan	1	1	2
Pastac	0	1	2
Pounce	1	3	6
Proclaim	1	10	20
Proclis	0	1	2
Prodigy	0	22	44
Prokali	0	1	2
Rampage	1	9	18
Ripcord	0	3	6
Rizotan	0	2	4
Rizotin	0	11	22
Spontan	0	1	2
Sumec	0	1	2
Sumibas	0	4	8
Sumition	1	1	2
Tamaron	0	3	6
Tokuthion	1	6	12
Topsin	0	1	2

Appendix 1. (Continued)

Commercial name	Formulation status	Number of farmers (n =50)	%
Trebon	1	1	2
Traser	1	50	100
Trigard	0	11	22

Formulation status: 1 = formally registered for *S. exigua*, 0 = not registered for *S. exigua*

Appendix 2. Commercial names of pesticide formulations to control *Spodoptera exigua* on shallot according to farmers in Cirebon, 2005

Commercial name	Formulation status	Number of farmers (n =50)	%
Agrimec	0	2	4
Agrotion	0	1	2
Akodan	0	3	6
Amate	1	2	4
Arrivo	1	1	2
Atabron	1	6	12
Azodrin	0	3	6
Basma	0	2	4
Bassa	0	2	4
Baycarb	0	3	6
Bayer	0	1	2
Baytroid	0	1	2
Brestan	0	2	4
Brown	0	1	2
Buldok	1	37	74
Callicron	0	1	2
Cascade	0	3	6
Cirotek	0	1	2
Curacron	1	25	50
Decis	0	23	46
Diazinon	0	1	2
Ditacron	0	1	2
Dursban	1	48	96
Furadan	0	1	2
Hostathion	1	45	90
Indobas	0	2	4
Kilat	1	5	10
Kwikuang	0	1	2
Lannate	1	2	4
Larvin	1	5	10
Lebaycid	0	2	4
Marshall	1	4	8
Matador	1	10	20
Mate	0	3	6
Metindo	1	19	38
Micindo	0	1	2
Mkd	0	1	2
Neril	0	1	2
Orthene	0	1	2
Oscar	0	5	10
Pastac	0	2	4

Appendix 2. (Continued)

Commercial name	Formulation status	Number of farmers (n =50)	%
Pele	0	1	2
Pounce	1	2	4
Proclaim	1	19	38
Prodigy	0	3	6
Promectin	0	1	2
Prothol	0	15	30
Rampage	1	9	18
Rasko	0	1	2
Redox	0	2	4
Regent	0	2	4
Ripcord	0	2	4

Appendix 2. (Continued)

Commercial name	Formulation status	Number of farmers (n =50)	%
Rizotin	0	1	2
Rudal	0	1	2
Score	0	1	2
Solone	0	1	2
Tamaron	0	1	2
Thiodan	0	3	6
Tiplo	0	1	2
Tokuthion	1	7	14
Traser	1	40	80
Trigard	0	10	20
Triton	0	2	4