Management Technique Against Spodoptera Exigua (Hübner) in the Different Elevation of Shallot

Sri Nur Aminah[1*], *Tamrin* Abdullah[1], and *Nidaul* Fajriani[2]

[1]Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University, 90245, Makassar, Indonesia
[2]Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University, 90245, Makassar, Indonesia

Abstract. *Spodoptera exigua* (Hübner) (beet armyworm) as the destructive insect pest in shallot. The purpose of the research is to determine difference of *S. exigua* management techniques based elevation in two different plantation. The research was conducted by collected primary data from shallot farmers in Anggeraja District (Mataran 650 m asl and Pekalobean 840 m asl) and Baraka District (Perarian 1.014 m asl and Parinding 638 m asl). The two places used in research is the center of shallot plantation in Enrekang Regency, South Sulawesi. The data was obtained by survey used 15 shallot farmers in each village. The results showed the control techniques different according to the elevation. *S. exigua* controlled by nylon nets only in areas < 700 m asl (Mataran 53% and Parinding 27%). In areas with elevation < 700 m asl (result of light trap in Mataran by 87% and Parinding by 80%). In the elevation > 700 m asl (result of light trap in Pekalobean about 100% and Perangian 0%). The mechanical control techniques by squeezing insect pest eggs at elevation of > 700 m asl (Pekalobean 93% and Perangian 6%), elevation of < 700 m asl (Mataran and Parinding both showed 60%). Conclusion of research, the control techniques different based on the elevation of shallot plantation.

1 Introduction

Shallot (*Allium ascalonicum*) family Liliaceae has a high value commodity around the world because very potential increasing farmer income. They are most popular spice increasing taste of food and useful as traditional herbal medicine. Commonly shallot growth intensively as monoculture and multiple cropping in the lowland and highland. The crops very adaptive and producing tuber in the paddy field (used the place after rice harvest), dry land and back yard. The different management of shallot growth in the lowland and highland based the material, commonly biological control more applied in the highland and intensively insecticide against insect pests in the lowland [1, 2, 3, 4].

* Corresponding author: nur-aminah@agri.unhas.ac.id

Spodoptera exigua (Hübner) (Lepidoptera: Noctuidae) or beet armyworm known as the destructive pest on the shallot plantation especially in South Sulawesi. As the important insect pest for shallot plantation and nurseries, the yield loss of *S. exigua* reached 100% without controlled [5, 6, 7]. *S. exigua* adult has ability spread very fast in the shallot plantation at lowland and highland. The presence of *S. exigua* still exist in the dry and wet season. The effective control of beet armyworm must be based on morphological, bioecology, symptom, behavior, primary and alternative host. The farmers control of *S. exigua* using synthetic insecticide in 2-3 times a week. In the extreme treatment, farmer mixed few of insecticide in the one application [8, 9]. Although the methods mixed and sprayed able controlled population of *S. exigua*, this way very dangerous then stimulate resistance and resurgence of insect pest. Beside poisonous to *S. exigua*, human and environment will be killing because water and soil pollution contaminated by residue of chemical insecticide. Newly report from Pathan et al. [10], beside shallot as the primary host, *S. exigua* find attack okra in India.

Enrekang Regency known as the center of shallot production in South Sulawesi. Enrekang has mountain topography and playing important roles as supplier many kind of vegetable to eastern part of Indonesia. The condition of plantation very important and impact to the price of shallot in the traditional market. The reported from [11], in 2020 shallot production in Enrekang increasing from 8.072 tonnes to be 102.878 tonnes. In 2021, shallot production still increasing to be 148.550 tonnes. In 2020, attack intensity of *S. exigua* in the Enrekang's shallot plantation around 280 hectare, then decreasing in 2021 to be 150 hectare. In 2022, attack intensity increased again to be 180 hectare. The larval as the very destructive stages in the shallot plantation because they are living inside the leaves. The original morphological of shallot leaves forming a tubular. The female of *S. exigua* laying eggs in the outer surface of host leaves. Newly larval make a small hole and enter to the shallot leaves. The immature stage complete inside the leaves and flying to atmosphere as the adult.

Impact of climate change affected growth and development of organism in the agricultural field. In few decades, presence and intencity level of plant pest attack increasing with the environmental change quality. Commonly management pest technique used mechanical technique, nylon nets and light traps believes control *S. exigua*. Beside the technique, another study reported *S. exigua* can control in many way using microbe [12]; plant extract [13, 14]; insect trap [15, 16, 17]; predator and parasitoid [17, 18]. Application of chemical insecticide still allowed if insect pest population outbreak, typical selective, narrow spectrum and used the chemical compound in the limited number [19]. Based insect pest behavior, it is not easier control of *S. exigua* except insecticide application. As we know the continuing insecticide application in the plantation will destroying food web and primary pollution of environment. Related to the presence of *S. exigua* in shallot plantation, the purpose of the research is to determine differences of *S. exigua* control techniques based elevation in two different places in Enrekang Regency.

2 Methodology

2.1 Research site

The research was conducted at farmers shallot plantation attacked by *S. exigua* in Enrekang Regency, South Sulawesi from November to December 2022.

2.2 Data collected from shallot farmers

Stages of research started by monitor and choose two separated shallot plantation based the elevation. The collected primary data from shallot farmers in Anggeraja District (Mataran

650 m asl and Pekalobean 840 m asl) and Baraka District (Perarian 1.014 m asl and Parinding 638 m asl). The two places is the center of shallot plantation in Enrekang Regency, South Sulawesi. The data was obtained by survey used 15 shallot farmers in each village (total 60 farmers). The data research based filling questionnaire and interview with farmers in their shallot plantation. The data focused on control insect technique without chemical application.

2.3 Data analysis and visualization

The data collected from the shallot farmers enter to the tabulation used formula [20]:

$$P = F/n \times 100\%$$

P: percentage
F: number of respondent
n: total of respondent

3 Result and discussion

Based the result of farmers questionnaire and condition of shallot plantation in Enrekang, development of agricultural technology has strong related to farmers formal education level. Result of shallot farmers education level showed in the Table 1.

Table 1. Shallot farmers level of formal education

Shallot farmers level of education	Elevation < 700 m asl (%)		Elevation > 700 m asl (%)	
	Mataran 650	Parinding 638	Pekalobean 840	Perangian 1014
Without education	0	0	0	0
Elementary school	7	7	7	7
Junior high school	7	40	7	27
Senior high school	67	53	67	60
Undergraduate	20	0	20	7

Level of education is very important for farmer adopted new technology to manage their plantation. Based the data from shallot farmers in Enrekang Regency, Table 1 showed the dominance of farmer education from senior high school in Pekalobean (67%) and Perangian (60%). The similar result showed in the shallot farmers from elevation < 700 m asl (Mataran 67% and Parinding 53%). Commonly farmers with the higher level education very easier understand new concept about technology management of insect pest. Related to farmers education, based data of interview farmers has two season planting a shallot. In elevation > 700 m asl, the highest farmers planting twice a year (Pekalobean 80% and Perangian 87%). In the elevation < 700 m asl (Mataran 60% and Parinding 53%). Schedule of planting shallot every year started around January to March and August to October. This is the best season for planting a shallot because weather condition supporting growth of crops in plantation.

The presence of insect pest in the agricultural plantation very important to control and probably caused yield loss. The control techniques of *S. exigua* in the shallot plantation based the different elevation showed in Table 2.

Table 2. Control techniques of *S. exigua* in the different shallot plantation based elevation.

Control techniques	Elevation < 700 m asl (%)		Elevation > 700 m asl (%)	
	Mataran 650	**Parinding 638**	**Pekalobean 840**	**Perangian 1014**
Nylon nets	53	27	0	0
Light trap	87	80	100	0
Mechanical control (squeezing *S. exigua* eggs)	60	60	93	6

Based the result of Table 2, shallot plantation in the different elevation showed difference applied of nylon nest controlled *S. exigua*. In Mataran and Parinding on the elevation < 700 m asl showed result of nylon nets 53 and 27%, respectively. In contrast, in the higher elevation (> 700 m asl) farmers not used nylon nets to control of *S. exigua*. Used of light trap attracted adult of *S. exigua* showed different result based the elevation. Two places in the elevation < 700 m asl showed successful 87% in Mataran and 80% in Parinding. In the places with higher elevation such as Pekalobean at 840 m asl, showed 100% successful used light trap. Unfortunately, the methods showed 0% in Perangian. As we know, mechanical control playing important roles as the simple and familiar technique controlling insect pest among farmers. This is a common methods in the agricultural practises. In the elevation < 700 m asl showed similar result 60% for Mataran and Parinding, The highest result showed in the higher elevation (more than 700 m asl) in the Pekalobean around 93%. The lowest result of mechanical control by squeezing of *S. exigua* eggs in Perangian (6%).

Fig. 1. Nylon net and light trap.

In this case, farmers believe new ecofriendly technology by nylon nets effective and reduce number of insecticide against *S. exigua*. In contrast, in the elevation more than 700 m asl, farmers not interesting because very expensive technology covering all of their shallot plantation. In the highland, nylon nets able increase humidity of micro habitat around the crop. It will be stimulate develop of plant pathogen such as fungi. Theresia et al. and Marsadi et al. [1, 5] reported that the highland with elevation more than 600 m asl, the temperature about 20 - 30°C. It means in the highland has low temperature that make crop difficult to growth.

Light trap has a function attracting adult of *S. exigua*. After mating, female *S. exigua* will laying eggs in the shallot leaves. Hatching from the eggs, larval started destroy leaves as the important site for photosynthesis and inhibit host develop well. Control population of *S.*

exigua used light trap, in areas > 700 m, the highest in the Pekalobean (100%), unfortunately farmers from Perangian not used the technology. The light trap able reduce population of adult *S. exigua* laying eggs and cost of controlled by chemical compound. In shallot plantation, farmers used Light Emitting Diode (LED) for light trap. The condition supporting by another research [15], LED has a primary function trapped adult of *S. exigua* and another moth with behavior nocturnal. Such as nylon nets technology, light trap LED in shallot plantation will reduce cost of synthetic insecticide and number of *S. exigua*. It means technology create shallot free from adult of *S. exigua*. Also the LED in violet color because it has long wave 380 – 450 nm. Wahyuni et al. [16] stated that violet LED suitable attracted moth in the night and help reduce number of insect pest in the field.

Squeezing insect eggs is very easier technology and showed direct effect decrease population of *S. exigua*. This way very effective if farmer monitoring their plantation periodically. In the elevation > 700 m, farmers squeezing insect eggs/larva highest in Pekalobean 93% and Perangian 6%, respectively. In areas < 700 m similar result 60% showed in Mataran and Parinding. Andani and Nasiruddin, Wahyuni et al. [16, 21] reported that squeezing eggs mass of *S. exigua* (estimated 80 eggs) very effective decreasing population of *S. exigua*.

Based on the farmers interview in two different elevation, they still choose used insecticide because result faster, easy to find and applicable in field. Unfortunately, this is a dangerous material. The problem against *S. exigua* used insecticide because larval living inside the leaves. For effectively control, farmer have to use systemic insecticide, but impact to consumer health because crop absorb the poisonous particle. Suradi [9] reported that insecticide very dangerous for consumer health and environment. Related to safety consumer and environment, Aminah et al. [22] reported that predatory insects around the plantation can working well if farmers manage presence of flowering weeds as the source of food and shelter for beneficial arthropods.

4 Conclusion

Conclusion of research, the control techniques different based on the elevation of shallot plantation. The dominant technique controlled *S. exigua* in the two shallot plantation is light trap and mechanical (squeezing insect pest eggs).

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