The Type Caterpillar of Lepidoptera Ordo and Control Techniques by Farmers for Soybean in South Sulawesi Indonesia.

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***Abstract*:This study aims to identify the type of caterpillar of Lepidoptera ordo and the level of damage to soybean on the sediment fields LakeTempe. Lake Tempe is area very potential for agricultural land during the dry season. One of the most planted commodities in the area is soybean. The main problem faced by farmers is the number of caterppilar pest attack on soybean leaves is high enough. Research on identification of caterpillar types that attack of soybean leave and insecticide application frequency by farmer was conducted at Tancung Village, Tanasitolo District, Wajo Regency and in Panincong Village, Soppeng Regency area of Lake Tempe, during Juli to November, 2016. The second activity is Experimental Garden of Agriculture in Maros during Augst to December 2016. The experiments were performed with Randomized Block Design with using three varieties i.e.Anjasmoro, Argomulyo, and Grobogan as treatments and three replications.The results show that there are 4 types of insect that damage soybean leaves around Lake Tempe *Spodoptera litura. S exempta* Wlk..*S.litura* is the dominant of insectr attacking soybean plants. The highest attack symptoms on Anjasmoro variety (between 31.6% until 35.22%,). Argomulyo variety gave the highest yield (18.98 g plant^{-1}).The intensity of soybean leaf damage is high enough, as a result, the farmers give high frequency of spraying.**

***Index Terms*: Soybean; Types of armyworm; damage intensity; insecticide; Lake Tempe area**

I. INTRODUCTION

Lake Tempe in dry season the volume of the water is 9,087 ha, while in the rainy season it will cover an area of 25, 858 ha (Suhur, 2015). This means that during the dry season there are about 16,771 ha that are not inundated with water and available for agricultural land. The land is very fertile because of the sedimentation during flooding and is very suitable to plant food crops including soybean, corn, green bean, chili, tomato, and other vegetable crops.

Soybean is one of the food crops that become the main program of the Ministry of Agriculture. There are several varieties of soybean recommended by the Ministry of Agriculture through Agricultural Research Agency such as Anjasmoro, Burangrang, Argomulyo, Dena-1, Gepak Kuning, Grobogan, Gema, and Kaba (RIPT, 2015). Varieties planted by farmers around Lake Tempe are Anjasmoro, Argomulyo, Grobogan, and Kaba. One of the serious problems faced by soybean farmers around Lake Tempe is pest attack, especially on soybean leaves.

Armyworm from the Lepidoptera Ordo are important pests of soybean, both in Indonesia and in some countries including the Americas, Europe, Asia and Australia. In tropical areas, there are about 60 insect species which can result in significant leaf damage on soybean (Panizziand Ferreira, 1997). Meanwhile, in India, there are about 150 insect species which can result in heavy damage on soybean from the planting period until the harvesting period (Ahirwar et al., 2013). In Asia, *S. litura* F. is an important polyphagus pest that can attack around 122 species from 44 plant families (Ghumare and Mukherjee, 2003). In Bangladesh about 15-20% of total soybean production is reduced due to caterpillar pests including *S. litura* (Biswas, 2013). In addition to soybeans, in India *S. litura* is also an important pest in tobacco with 25-50% damage rate (Patil et al., 2014) and Rao et al. (2014), *S. litura*.can result in tobacco yield loss with an approximate rate of 35-50% . In cotton plants, in India, *S. litura* can result in a yield loss of 25.8-100% (Shilpa and Remia, 2017).

In Indonesia, armyworm can be found in several types of plants such as tobacco, onion, peanut, soybean and potato (Kalshoven, 1981). Meanwhile, according to Kranz et al. (1978), armyworm can attack several types of plants with a degree of damage to tobacco 23-50%, and in peanut the damage symptoms is about 33%. Meanwhile, according to Santi and Krisnawati (2016), armyworm *S. litura* is an important pest on soybean with a leaf damage rate is about 80% in Indonesia.

In South Sulawesi, the level of soybean damage caused by armyworm ranged from 12.11% to 45.26% (Fattah and Hamka, 2012).The rate of armyworm attack on soybean around Lake Tempe area is quite high (30-65%) (ATRC, 2015). To reduce the rate of armyworm attacks on soybeans, farmers perform the frequency of insecticide spraying 1-3 times per week. If it is left constantly, then it will result in the killing of predators, fish, birds and will disturb human health. Therefore, it is necessary to recommend threshold control of armyworm especially on some dominant soybean varieties planted by farmers in Tempe Lake

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area. This study aims to identification of insect types and its symptoms for soybean. Therefore, it is to assessment the application frequency of insecticide by farmers for soybean in Lake Tempe, South Sulawesi, Indonesia.

II. MATERIALS AND METHODS

Research on identification of types caterpillar of Lepidoptera ordo and it's damage of soybean and insecticide application frequency by farmer was conducted at Tancung Village, Tanasitolo District, Wajo Regency and in Panincong Village, Soppeng Regency area of Lake Tempe, during Juli to November, 2016. The second activity is testing the three varieties: Anjasmoro, Argomulyo, and Grobogan on damage intensity of caterppilar for soybean that was conducted at Experimental Garden of Agriculture in Maros during Augst to December 2016. This experiment was conducted with The experiments were performed with Randomized Block Design with using three varieties i.e.Anjasmoro, Argomulyo, and Grobogan and three replications.
Leaf damage intensity is calculated based on the following formula:

$$I = \frac{\sum_{i=0}^{x}(n_1 \; x \; v_1)}{Z \times N} \times 100\%$$

I = Attack intensity
$n_1 = Number\ of\ leaves\ observed\ at\ v_1$
v_1 = The value of leafe damage at the i leaf
N = $Number\ of\ leaves\ observed$
Z = The highest scale value to leaf damage
I =Scale Value:
0 = no damage to leaves
1 = Leaf damage> 0 - 20%
3 = Leaf damage> 20 - 40%
5 = Leaf damage> 40 - 60%
7 = Leaf damage> 60 - 80%
9 = Leaf damage> 80 - 100%

Other parameters observed including seed yield and decreased seed yield from larval attacks were also observed.

Statistic analysis

All observed data were analyzed using variance analysis (ANOVA). The comparison of mean leaf damage intensity caused by *S. litura* and other parameters was made using the LSD test at a 5% probability level.

III. RESULTS AND DISCUSSION

Types of soybean varieties planted by farmers and the symptoms of *S. litura* attack on sedimentary land around lake tempe

Symptoms of attack on soybean leaves due to *S.litura* on three varieties Anjasmoro, Argomulyo, and Grobogan differed on observations in Cenranae, Tancung, and Panincong. The damage intensity on Anjasmoro, Argomulyo, and Grobogan varieties is different. The highest attack symptom on Anjasmoro variety was between 31.6% until 35.22%, while the lowest was in Grobogan varieties was between 23.96% until 26.53%. There are several factors that affect the resistance of a variety of strains of *S. litura* including physical factors plant height. In Table 2, Grobogan varieties have the lowest plant height (42.35 cm) compared to other varieties. It is assumed to be one of the factors affecting the low incidence of attacks on Grobogan. This is in accordance with Nugrahaeni et al. (2013), strains or varieties that have shorter stems, are more resistant to grayak caterpillar larvae attacks.

Table 1. Intensity of damage and seed yields on three varieties of soybean.

Varieties	Damage Intensity (%)			Seed yield (g tan-^{1})
	Cenranae	Tancung	Panincong	
Anjasmoro	35.22 a	34.71 a	31..65 a	18,06 b
Argomulyo	28.88 b	28.39 b	26.90 b	18.98 a
Grobogan	26.14 c	26.53 c	23.96 c	17.03 c

The column number (followed by the similar letter) has no significant difference at 5% LSD Test

Seed yields of the three varieties, Argomulyo gave the highest yield (18.98 g plant^{-1}) and differed significantly from the varieties of Anjasmoro and Grobogan. One of the factors that support the high yield of seeds in Argomulyo, among others, is the lower attack symptoms on it than on Anjasmoro. While Grobogan varieties that have low attack symptoms, but the yield of seeds

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is also low (17.03 g plant^{-1}). One of the causes, Grobogan varieties, the number of pods produced is lower than the others (70.90 plant^{-1}).

Table 2. Average plant height, number of branches, and number of pods per plant

Varieties	Plant height (cm)	Number of branches	Number of pods
Anjasmoro	73,35 a	6.20 a	81.80 a
Argomulyo	66,40a	5.55 a	79.35 b
Grobogan	43,10b	3.55 b	70.90 c

The column number (followed by the similar letter) has no significant difference at 5% LSD / BNT Test

The types of armyworm found in soybeans in sediment fields of Tempe Lake

The results of identification of armyworm species found in sediment fields of Lake Tempe as a center of soybean development in South Sulawesi found among others insect (Figure 1).

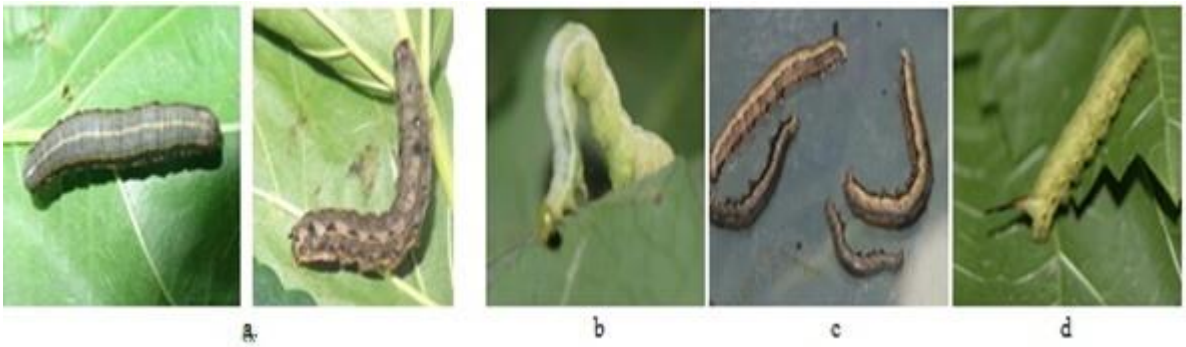

Figure 1. Types of caterppilar of Lepidoptera ordo found in soybean crops around sediment fields of Lake Tempe.

Figures (1a) is considered *S.litura* because they have characteristics corresponding to Kalshoven (1981) the larvae of *S. litura* have varying color features, they possess two characteristic blind crescents on the 4th and 10th abdominal segments, bordered by yellow lateral and dorsal strips. Meanwhile, according to Kranz et al.(1978), the young larvae are green with patches on each side of the first and last abdominal segments. In late instars, the larvae are dirty brown with five thin orange line along the body, two on each sides and one in mind–dorsal position. These black spot and patches are very useful diagnostic criteria. *S.litura* caterpillar is the most destructive pest of soybean crops in the area of Lake Tempe. While ***C. chalcites*** Esp. (Figure 1b), have characteristics of Caterpillar *C. Chalcites* Esp is green with white/bright lines along the sides of the body from the head. The large 3 cm long larvae have two pairs of false limbs on the front of the abdomen (thorax) and a pair on the back. The body of the caterpillar narrows at the end with a small head. The cocoons are initially light green, gradually turning brownish white. A cocoon is formed on a leaf, covered by a cocoon house (cocoon). The cocoon stage lasts 6-11 days with a mean of 6,8 days. The moth stage lasts 5-12 days with an average of 8.5. Moths lay eggs at 4-12 days old. Egg production reaches 1,250 eggs per female moth. Eggs are placed individually on the underside of leaf blades. The egg stage lasts 3-4 days with an average of 3.2 days. Life cycle of the caterpillar from egg to moth spawn lasts for 30 days (Inayati and Marwoto, 2011). *C.chalcites* Esp. belong to the Noctuidae family and attack several types of plants (polyphagous) including soybean, potatoes, and tomatoes (Kalshoven, 1981).

S.exempta Wlk larvae (Figure 1c) has characteristics, the caterpillars exhibit a marked colour variation, as density dependent colouration or phase change, semilar to that in locusts occurs. After each moult, a new skin stars as an almost colourless 1st instar, becoming progressively greener, then dark with the growth of numerrous black bristles. The darkening of larva is often associated with increasing density (Kranz et al., 1978).*Agrius convolvuli* L larvae (Figure 1d), has characteristics, the larvae is very variable in colour : green, brown, or black. The host plants include wild *Ipomea* spp. These pests belong to the Family of Sphingidae, Order of Lepidoptera (Kashoven, 1981). This pest in the area of Lake Tempe rarely found attacking soybean, there are only a lot of plants found kale.

The use of insecticides in the control of insect for soybean

When the insecticide application is in control of grayak caterpillar on soybean, farmers use spray tool with spray volume of 500 liters ha^{-1} with a dose of 2 cc liter^{-1} of water, the amount of insecticide used by farmers is about 1 liter every one application. When the application of insecticide 3 times every week, then the amount of insecticide which is about 3 liters every week and 12 liters every month. Farmers generally spray insecticides on soybeans from vegetative to generative for two months. So the amount of insecticide used for one planting season per ha is about 24 liters. If compiled to the value of rupiah with the price of deltametrin insecticide at the farm level of about Rp 150,000 liter^{-1}. So the insecticidal costs incurred by farmers for spraying 3 times per week is about Rp 3,600,000 ha^{-1}. When compared with the yield of seeds reached 2,550 kg with the price of soybean Rp 7,000 per kg, then the sale gained by farmers is about Rp 17,850,000.

When using standard spraying 2 times every week, the amount of insecticide used by farmers around for one planting season is about 16 liters. If the insecticide price is Rp 150,000 liter^{-1}, the farmers' expense for insecticide cost is around Rp 2,400,000 ha^{-1}.

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Table 3. Intensity of damage and seed yields for four application insecticides for *S.litura*F. on soybean

Frequency of Spraying	Intensity of Damage (%)	Seed yield (t/ha)
3 times every week	11,450 d	2,550 a
2 times every week	18,210 c	2,480 a
1 times every week	22,210 b	2,210 b
1 time every two weeks	39,110 a	1,980 c

The column number (followed by the similar letter) has no significant difference at 5% LSD/BNT Test

When the application of insecticide 1 times every week, then the number of insecticides used by farmers per ha is about 8 liters. So if the price of insecticide Rp 150.000 liter^{-1}, then the farmers' expense to buy insecticide is about Rp 1,200.000 ha^{-1}. When the application of insecticide is done once per two weeks, then the amount of insecticide used by farmer planting season per ha is about 4 liters. If the price of insecticide per liter is Rp 150,000, then the cost incurred by farmers is around Rp 600,000 ha^{-1}.

Most interestingly discussed here is the impact of insecticide use on organisms that are around Lake Tempe. If the area of soybean cultivation around the area of Lake Tempe is about 3,000-10,000 ha every planting season, then the number of insecticides is used by farmers about 12,000-40,000 l every planting season. The number of insecticides used by farmers in the control of armyworm has a great opportunity to negatively impact the useful organisms and other animals and humans. Types of insecticides used by soybean farmers around Lake Tempe in the control of armyworm are from deltamethrin group (Decis 50 EC), permethrin (Klensect 50 EC), sipermermetrin (Unimetrin 100 EC), chloroprisfos + sipermetrin (Halona 250 + 50 EC) dan lamba sihalotrin (Lampion 25 EC and Salvador 25 EC).

When spraying insecticides in the control of insect by farmers in the area of Lake Tempe, if not addressed wisely, it will make other organisms such as pest predators (natural enemies), fish, birds, and other animals in the area Lake Tempe will become extinct. According to Setiawati et al.(2015), the use of carbofuran insecticides can suppress potato tuber damage of 56.79-58.38%; however, the use of carbofuran insecticides can reduce the abundance of population of soil arthropods by 30.67-34.32%. According to Hasibuan (2004), the application of insecticide isoprocarb (Mipcin 50 WP) in sugarcane cultivation can significantly decrease the population density of insect predators, ie 3.3 heads per stem (insecticide use) and 10.1 heads per stem (without insecticide). Furthermore, Hendrival and Khalid (2017), the higher the value of species diversity in a habitat, then the balance of the community will also be higher. Soybean agroecosystem without insecticide application shows a high community balance with high diversity of *Hymenoptera* parasitoid types as well.The use of insecticides causes insects to evolve towards resistant to the pesticide. More pest problems, secondary outbreaks, destruction of natural enemies such as parasitoids or predators and useful insects, residency and poisoning as a result of excessive and inadvertent use of pesticides (Siregar, 2015).According to Gazzioni et al. (1999), Lambda sihalothrin at 4,5 or 9 g a.i.ha^{-1} reduces the number of predators (spiders) of soybean pests, while other tested insecticides only affect the predators number at the highest dose. Indoxacarb and spinosad resulted in close to 30% mortality to the predator, and were classified as slightly harmful, while the fungicide copper hydroxide caused 58% mortality and was rated as moderately harmful (Martinou et al.,2013). According to Purwanta and Rauf (2000), all types of insecticides from the BPMC, Prefenofos, and Deltamethrin groups can kill and decrease the predator populations of the Atropods (spiders), especially the Linyphiidae, Salticidae, and Oxyyopidae families.

According to Adriyani (2006), excessive use of pesticides will have a negative impact on human health, the environment, water and soil pollution, air, damage to ecosystem balance, pest resistant, secondary pest and resurgence. The negative impacts of insecticide applications on human health when the insecticides used by farmers generate residues in plants or bioaccumulation and biomagnification through the food chain. The effect of insecticide application on water and soil contamination occurs when granular-shaped pesticides applied through soil will undergo a process in soil and water that can contaminate water and soil. While air pollution occurs when the application of insecticide through spraying will be mixed with air and directly exposed to sunlight can experience photodecomposition in air and will be carried by the wind. Another negative effect of pesticide use is to damage the balance of ecosystems as it can kill predators and parasitoids.

IV. CONCLUSION

In conclusion, the soybean cultivation area around Lake Tempe has found 4 types of caterpillars of Lepidoptera ordo that attack for soybean namely *S. litura* F., *S exempta* Wlk.., *C.chalcites* Esp., *and A. convolvuli*L..*S.litura* is the dominant armyworm caterpillar attacking soybean plants. The highest attack symptom on Anjasmoro variety.The frequency of insecticide application 3 times per week, the intensity of *S. litura* attack was significantly different, but the yield of seeds achieved by farmers was not significantly different. The application of insecticides in the control of armyworm is quite high, so it will have an impact on the killing of useful animals such as fish, pollinating insects, predators, parasitoids and birds and damaging human health.

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