Spodoptera litura as a main pest in oil palm peat plantation

D Bakti, M D S Saragih, I Safni and S H Pasaribu

Department of Agroteknologi, Universitas Sumatera Utara, Prof. A. Sofyan No. 3 Kampus USU, Medan, Indonesia Republic - 20155.

Email: darma@usu.ac.id or dbakti06@yahoo.com

Abstract. Nowadays oil palm plantation is attacked by Spodoptera litura especially in peat land plantation. This research was aimed to find out the types of host plants most preferred by larvae of S. litura. This research was conducted in 2 stages, the 1st stage used Randomized Block Design Factorial consisting of 2 factors, which was the origin of the larvae and the commodity with 16 combinations of treatments, the 2nd stage used Non Factorial Randomized Block Design with 2 treatment combinations, P1: Oil palm + Coconut + Sugar palm + Areca nut + Soybean + Green bean + Peanut + Mucuna bracteata + 40 S. litura original from Oil palm, and P2: Oil palm + Coconut + Sugar palm + Areca nut + Soybean + Green bean + Peanut + Mucuna bracteata + 40 S. litura original from Soybean. The results showed that the preference of S. litura original from oil palm to the tested plants were Mucuna bracteata, Soybean, Green bean, Peanut, Oil palm, Areca nut, Sugar palm and Coconut. The preference of S. litura original from Soybean to the tested plants were Soybean, Mucuna bracteata, Peanut, Green bean, Oil palm, Areca nut, Coconut and Sugar palm.

1. Introduction

Oil palm (Elaeis guineensis Jacq.) is one of the plantation commodities that has an important role in economic development in Indonesia. The potential market that will absorb the marketing of Crude Palm Oil (CPO) and Palm Kernel Oil (PKO) is the fractionation/refinement industry (Especially the fried oil industry), special fats (Cocoa butter substitute), cosmetics ingredients, margarine/shortening, oleochemical, and bath soaps [1]. In 2015, the expansion and production area of oil palm plantations is increase. Plantation area in Indonesia reaches 11.300.370 ha with production of 31.284.306 tons. North Sumatra has of 1.186.866 ha with total production of 5.099.246 tons [2]. The cultivation of oil palm can not be separated from various obstacles. The cultivation of oil palm plants is the attack of Plant Disturbing Organisms (PDO) consisting of pests, pathogens, weed leaves.

Armyworm or Spodoptera litura (Lepidoptera: Noctuidae) is a pest that often causes damage to soybean crops in Indonesia, especially in the dry season. Armyworm attacks in the vegetative growth phase can reduce yield up to 80%, armyworm is seen as one of the obstacles to soybean production. This pest is widespread, especially in hot and humid climates, from subtropics to tropical regions [3]. The level of insects eating preference depends on a variety of chemical constituents that affect the acceptance and rejection of the pest. This is related to primary compounds and secondary metabolic compounds found in host plants, and can be a limiting factor for insect pests to eat plant tissue. Insect biological behavior is closely related to the availability of plants as a source of quality food to ensure the survival of its larvae [1].
2. Material and Methods
The research was carried out in Asian Agri Group oil palm plantation, PT. Hari Sawit Jaya Selatan Negeri Lama, Sei Tarolat, Kuala Hilir, Labuhan Batu, starts from August 2017 to October 2017. The materials used in this research included 10-month-old Oil palm seeds, 9-month-old Coconut seedlings, 9-month-old of Coconut seeds, 9-month-old of Palm sugar seeds, 25-day old of Soybean plants, 25-day old of Green bean, Peanuts aged 25 days after planting, *Mucuna bracteata* aged 40 days after planting, larvae of *S. litura* original from oil palm plants, larvae of *S. litura* original from soybean plants, hoods, bamboo, plastic straps, wire, labels, topsoil, and polybags. The tools used in this study include jars, knives, organdy cloth, machetes, saws, scissors, label paper, cameras, stationery and other supporting tools.

This research carried out in 2 stages, Phase I (Forced feed test) using Factorial Randomized Block Design with two factors, 1st factor: Worm origin were (A); A1: Oil palm; A2: Soybean; 2nd factor: Commodity (K); K1: Oil palm; K2: Coconut; K3: Sugar palm; K4: Areca nut; K5: Soybean; K6: Green bean; K7: Peanut; K8: *M. bracteata*. Phase II (Paired feed test) used Non Factorial Randomized Block Design with the following treatments; P1: Oil palm + Coconut + Sugar palm + Areca nut+ Soybean + Green bean + Peanut + *M. bracteata* + 40 *S. litura* larvae original from oil palm; P2: Oil palm + Coconut + Sugar palm + Areca nut+ Soybean + Green bean + Peanut + *M. bracteata* + 40 *S. litura* larvae original from soybeans.

The data were analyzed by ANOVA (*Analysis of Variance*) in each measured parameter. Further tests were carried out for significant treatment using Duncan Multiple Range Test at α 5%.

3. Results and Discussion

3.1 Percentage of *Spodoptera litura*’s attacked on forced feed test
In the preference test, *S. litura* was carried out by calculating the intensity of *S. litura* attacked with the score method, oil palm, coconut, sugar palm, areca nut, soybean, green bean, peanut, and *M. bracteata* applied result in a different percentage of *S. litura*’s attacks (Table 1).

| Treatments | I Observation 2 DAI | II Observation 4 DAI | III Observation 6 DAI | IV Observation 8 DAI | V Observation 10 DAI |
|------------|---------------------|----------------------|-----------------------|----------------------|----------------------|
| K1         | 6.10 c              | 11.28 b              | 13.87 a               | 15.58 c              | 32.27 c              |
| K2         | 0.00 e              | 0.00 c               | 0.00 e                | 0.00 d               | 0.00 e               |
| K3         | 1.52 d              | 1.52 c               | 1.52 de               | 1.52 d               | 1.52 de              |
| K4         | 5.00 cd             | 8.33 b               | 8.33 cd               | 8.33 cd              | 8.33 d               |
| K5         | 14.87 ab            | 38.57 a              | 49.08 a               | 65.12 a              | 77.40 a              |
| K6         | 17.52 a             | 24.92 a              | 26.47 b               | 39.20 b              | 39.72 bc             |
| K7         | 10.43 bc            | 29.77 a              | 45.57 a               | 55.93 b              | 55.93 b              |
| K8         | 17.52 ab            | 38.30 a              | 45.65 a               | 75.80 a              | 82.02 a              |

Average followed by the same letter in column is not significantly different at the 5% level according to Duncan’s multiple distance test. K1: Oil palm, K2: Coconut, K3: Sugar palm, K4: Areca nut, K5: Soybean, K6: Mung bean, K7: Peanut, K8: *Mucuna bracteata*.

Table 1 shows that in II observation 4 DAI the percentage intensity of *S. litura* attacks on palmae plants had a significant effect on legume plants. This is due to different morphological forms of palmae leaves and legumes, which affects the intensity of larvae attacks in the feeding process. [4] explained that plant...
resistance is carried out by the presence of structural properties or plant morphology which can prevent the occurrence of eating and egg laying.

The highest attack of \textit{S. litura} was found in K8 treatment (\textit{M. bracteata}) which was 82.02%. This can be seen from the leaves of \textit{M. bracteata} which leave only the remains of the upper part of the epidermis of the leaves. The lowest \textit{S. litura} attacked on K2 (Coconut) treatment was 0.00%. This can be seen in leaves with no attacked by \textit{S. litura} larvae. According to [5] young larvae damage the leaves by leaving the remnants of the upper epidermis (Transparent) and the leaf bones. Advanced instar larvae damage the leaf bones and sometimes attacking the pods.

The results of the II observation on 4 DAI, namely palm trees were significantly different from legume plants. For the whole observation that the intensity of the attacks of \textit{S. litura} in each commodity varies in each observation. This is because some test plants have wax layers, trichomes that affect the larvae to eat the test plants. According to [6] the presence of thick and dense leaf feathers in leguminose plants, so that for the mouth of the insect will be difficult to reach the leaf tissue, the presence of a wax layer will also reduce its destruction.

Palm trees do not have a severe attack compared to legume plants. This is due to the nature of plant resistance to pest disturbances. This is in accordance with [6] which stated that one of the physiological aspects associated with the nature of plant resistance to pest disturbances, among others, is the properties of leaves, namely a type of tree can be resistant to pest disturbances by the presence of morphologically can function as an inhibitor.

Commodities that are quite heavily attacked after infestation of \textit{S. litura} larvae is \textit{M. bracteata} that is able to live in the dry season and rainy season. [5] Stated that severe attacks of \textit{S. litura} occur in the dry season, when the average humidity among 70% and air temperature between 18-23%. Leaf damage caused by small larvae damage the leaves by leaving the remnants of the upper epidermis, transparent and leaves the leaves.

3.2 The effect of origin larvae on the attack intensity of \textit{Spodoptera litura}

The result Varian Data analysis swoed that origin of worm in I – V observations were not significant to \textit{S. litura} attacked intensity percentage. The effect of larvae origin on data observational on forced feed test is different. Adaptation of each larva from different origin is important to support the life of the larvae in its life maintaining. Data obtained from different larvae \textit{S. litura} prefer plants that have a soft leaf texture and plants that have become host plants. This will be seen in the leaves that leave the attack symptoms, the leaves are not intact (Table 2).

| Treatments | I Observation | II Observation | III Observation | IV Observation | V Observation |
|------------|--------------|---------------|----------------|---------------|--------------|
| A1         | 9.00         | 18.42         | 22.68          | 30.01         | 35.14        |
| A2         | 9.24         | 19.75         | 24.94          | 35.36         | 39.16        |

A1 : \textit{Spodoptera litura} original form oil palm, A2 : \textit{Spodoptera litura} original from soybean.

The highest attack of \textit{S. litura} was on treatment of \textit{S. litura} original from soybeans with percentage 9.24%. This is because \textit{S. litura} from soybeans is better able to adapt to the environment and all plants tested. The lowest treatment found in \textit{S. litura} original from oil palm with percentage 9.00%. This is because \textit{S. litura} comes from oil palm which has not been able to adapt to all the test plants so it cannot survive, besides the leaf morphology affects the level of pest resistance in maintaining its life. [6] Stated
that one of the physiological aspects related to the nature of plant resistance to pest disorders, among others are: the properties of the leaves that is a type of tree can be resistant to pest disturbance by the presence of morphological leaf properties as an inhibitor, morphological properties include thick tissue so that insects have difficulty being able to eat it, the hairs on the leaves (trichomes) are thick and tight so that for the mouth tools insects will be difficult to reach the leaf tissue, the wax layer is also will extinguish the damage. These properties are responsible for the formation of a mechanism of non-preference resistance in plants.

The treatment of S. litura from oil palm in I-V observation had a low attack percentage compared to treatment S. litura original from soybeans. This is due to the level of hardness of the leaves so that pests do not like them. In addition, it is also determined by the morphological resistance of each variety such as leaf size, shape, color, hardness of tissue, feathers or hair and others. According to [9] stated that leaf morphology such as hair, thorns, hardness and wax coating can interfere with the host selection process as feed ingredients, marriage and egg laying.

3.3 The effect of the type commodity interaction and the origin of larvae on Spodoptera litura attacks intensity

The results of the analysis of variance on the percentage of S. litura attacks showed that the interaction between the commodity and the origin of worm showed insignificant effect. Different origin of S. litura has a different level of preference for the plants tested, the most preferred commodity are M. bracteata plants seen in V observation (10 DAI) of each S. litura has a high attack intensity (Table 3.)

| Treatments | I Observation | II Observation | III Observation | IV Observation | V Observation |
|------------|---------------|----------------|----------------|---------------|---------------|
| A1K1       | 4.17          | 8.33           | 10.83          | 10.83         | 31.67         |
| A1K2       | 0.00          | 0.00           | 0.00           | 0.00          | 0.00          |
| A1K3       | 3.03          | 3.03           | 3.03           | 3.03          | 3.03          |
| A1K4       | 6.67          | 11.67          | 11.67          | 11.67         | 11.67         |
| A1K5       | 13.50         | 37.77          | 45.27          | 59.40         | 73.80         |
| A1K6       | 17.67         | 26.03          | 29.13          | 38.53         | 38.53         |
| A1K7       | 10.47         | 22.83          | 35.67          | 35.67         | 35.67         |
| A1K8       | 16.50         | 37.70          | 45.83          | 80.93         | 86.73         |
| A2K1       | 8.03          | 14.23          | 16.91          | 20.33         | 32.87         |
| A2K2       | 0.00          | 0.00           | 0.00           | 0.00          | 0.00          |
| A2K3       | 0.00          | 0.00           | 0.00           | 0.00          | 0.00          |
| A2K4       | 3.33          | 5.00           | 5.00           | 5.00          | 5.00          |
| A2K5       | 16.23         | 39.37          | 52.90          | 70.83         | 81.00         |
| A2K6       | 17.37         | 23.80          | 23.80          | 39.87         | 40.90         |
| A2K7       | 10.40         | 36.70          | 55.47          | 76.20         | 76.20         |
| A2K8       | 18.53         | 38.90          | 45.47          | 70.67         | 77.30         |

A1: Spodoptera litura original from oil palm, A2: Spodoptera litura original from soybeans, K1: oil palm, K2: Coconut, K3: Sugar palm, K4: Areca nut, K5: Soybeans, K6: Green beans, K7: Peanuts, K8: Mucuna bracteata.
Table 3 shows that the treatments of A1K8 86.73% and A2K8 77.30%. This can be seen from the leaves of *M. bracteata* which only remain in the epidermis and leaf bones. [5] Stated that young larvae damage the leaves by leaving the remnants of the upper epidermis (Transparent) and leaf bones. Advanced instar larvae damage the leaf bones and sometimes attack the pods.

In the 1 observation 2 DAI the highest *S. litura* attack was found in *S. litura* original from soybean to *M. bracteata* plants treatments which amounted 18.53%. This is because *M. bracteata* leaves contain enough water. The data lowest in *S. litura* original from oil palm to coconut treatments, *S. litura* original from soybean to coconut, and *S. litura* original from soybean to palm sugar treatments which 0.00%, this is due to coconut leaves palm, coconut, and sugar palm are very hard which only contains a little water. According to [7] stated that the water content of *M. bracteata* is 66.192% while for oil palm plants is 63.549%.

3.4 Percentage of *Spodoptera litura* mortality in forced feed test

The mortality of *S. litura* from oil palm is significantly different from *S. litura* from soybeans. This can be seen in treatment of A1K1 to A2K1, A1K5 to A2K5, A1K7 to A2K7 and A1K8 to A2K8. This is because the larvae have not adapted to the environment so that the larvae was die. Accordance with [8] explained that insects like other living things whose development is influenced by climatic factors both directly and indirectly including rainfall, temperature, relative humidity and photoperiodicity.

**Table 4.** Average percentage of *S. litura* larvae mortality (%) in the forced feed test

| Treatments  | Average  |
|-------------|----------|
| A1K1        | 76.67 bc |
| A1K2        | 100.00 a |
| A1K3        | 100.00 a |
| A1K4        | 100.00 a |
| A1K5        | 66.67 c  |
| A1K6        | 83.33 b  |
| A1K7        | 80.00 b  |
| A1K8        | 43.33 d  |
| A2K1        | 93.33 a  |
| A2K2        | 100.00 a |
| A2K3        | 100.00 a |
| A2K4        | 100.00 a |
| A2K5        | 53.33 d  |
| A2K6        | 73.33 bc |
| A2K7        | 50.00 d  |
| A2K8        | 30.00 e  |

Average followed by the same letter in column is not significantly different at the 5% level according to Duncan’s multiple distance test. A1: *Spodoptera litura* original from oil palm, A2: *Spodoptera litura* original from soybeans, K1: Oil palm, K2: Coconut, K3: Sugar palm, K4: Areca nut, K5: Soybean, K6: Mung bean, K7: Peanut, K8: *Mucuna bracteata*.

The highest data on *S. litura* mortality original from oil palm and soybean were found in coconut, sugar palm and areca nut with total 100%. The lowest mortality was found in *M. bracteata* with 43.33% (Original of larvae from oil palm) and 30.00% (Original of larvae from soybeans). This is because the *M. bracteata* plant has high water content and low fiber content compared to palmae plants. [5] Stated that the *M. bracteata* plant has a water content of 63.549%, 28.774% of protein, 21.239% of fiber content, and 7.649% of carbohydrate.
In the soybean and mung bean test plants from different S. litura larvae origin has a different percentage. Mortality in mung bean plants is higher than mortality in soybean plants, this is because the green bean leaves have more trichomes that can block the movement of larvae to eat the test plants. The tricoma is a form of plant defense against larva attacks. [6] Stated that one of the physiological aspects associated with the nature of plant resistance to pest disorders include: thick tissue so that insects have difficulty being able for eat, the hairs on the leaves (Trichomes) are thick and tight so that the insect mouth will be difficult to reach the leaf tissue (Table 4).

### 3.5 Percentage of attack on Spodoptera litura in feed select test

Intensity of attack on select feed tests for palms from different worm origin is very different. The highest intensity of attack is in the form of oil palm, areca nut, sugar palm and coconut (Table 5). This is because the worm original from oil palm have adapted to oil palm plants and have not adapted to other palms so that larvae prefer oil palm.

| Perlakuan          | Attack Intensity Percentage (%) of S. litura |
|--------------------|---------------------------------------------|
|                    | I Observation | II Observation | III Observation | IV Observation | V Observation |
|                    | 2 DAI         | 4 DAI          | 6 DAI           | 8 DAI          | 10 DAI        |
| P1 Oil palm        | 3.50 c        | 22.20 c        | 31.67 b         | 36.67 b        | 37.50 b       |
| P1 Coconut         | 0.00 d        | 0.00 d         | 0.00 c          | 0.00 c         | 0.00 c        |
| P1 Sugar palm      | 0.00 d        | 0.00 d         | 0.00 c          | 0.00 c         | 0.00 c        |
| P1 Areca nut       | 0.00 d        | 0.00 d         | 0.00 c          | 0.00 c         | 0.00 c        |
| P1 Soybean         | 11.53 b       | 52.77 ab       | 86.20 a         | 93.99 a        | 94.59 a       |
| P1 Green bean      | 9.70 b        | 60.73 ab       | 85.40 a         | 92.70 a        | 96.87 a       |
| P1 Peanut          | 8.87 b        | 54.57 ab       | 83.35 a         | 89.50 a        | 89.90 a       |
| P1 Mucuna bracteata | 18.00 a      | 59.57 ab       | 83.43 a         | 89.03 a        | 88.20 a       |
| P2 Oil palm        | 1.67 cd       | 8.53 d         | 19.70 bc        | 24.17 b        | 24.17 b       |
| P2 Coconut         | 0.00 d        | 0.00 d         | 0.00 c          | 0.00 c         | 0.00 c        |
| P2 Sugar palm      | 0.00 d        | 0.00 d         | 0.00 c          | 0.00 c         | 0.00 c        |
| P2 Areca nut       | 0.00 d        | 0.00 d         | 0.00 c          | 1.67 c         | 1.67 c        |
| P2 Soybean         | 10.10 b       | 50.43 ab       | 77.77 a         | 81.67 a        | 82.23 a       |
| P2 Green bean      | 14.20 ab      | 42.83 abc      | 71.63 a         | 85.10 a        | 89.27 a       |
| P2 Peanut          | 10.40 b       | 37.65 bc       | 70.90 a         | 74.80 a        | 76.73 a       |
| P2 Mucuna bracteata| 20.70 a       | 65.20 a        | 76.70 a         | 79.47 a        | 84.46 a       |

Average followed by the same letter in column is not significantly different at the 5% level according to Duncan's multiple distance test. P1 : Spodoptera litura original oil palm, P2 : Spodoptera litura original from soybean.

Table 5 shows that in II observation 4 DAI the percentage of the intensity of the attack of S. litura original from oil palm on the oil palm test plants with S. litura original from soybean on oil palm test plants had a significant difference. This is due to the origin of different worms so that there is no adaptation to the test plants and new environments. [8] states that insects like other living things whose development is influenced by climatic factors both directly and indirectly including rainfall, temperature, relative humidity and photoperiodicity.
In the V observation 10 DAI observation the highest percentage was found in treatment oil palm + coconut + sugar palm + areca nut + soybean + green bean + peanut + M. bracteata + 40 tails of S. litura (origin from oil palm) that is equal to 96.87% in mung bean plants. The lowest in P2 treatment (oil palm + coconut + sugar palm + areca nut + soybean + green bean + peanut + M. bracteata + 40 S. litura original from soybean) with percentage 89.27% in mung bean plants.

3.6 Spodoptera litura condition

The condition of S. litura based on original from oil palm and soybean in forced testing showed that S. litura original from oil palm and soybeans were able to survive and complete their life cycle longer if they ate legume plants, and would die quickly when eating palm trees.

Table 6. Condition of Spodoptera litura origin from oil palm and soybean based forces test

| Types of Plants | Larvae Condition | Oil Palm | Soybean |
|-----------------|------------------|---------|---------|
| Oil palm        | Eat less and are unable to complete the life cycle, the larvae die on the 10th day with attacked intensity of 31.67% | Larvae only ate little and were unable to complete their life cycle and died on the 11th day with an attack intensity of 32.87% |
| Coconut         | Don't eat and die after 1 day with 0% attack intensity | Do not eat and die after 1-2 days with an intensity of attacks of 0% |
| Sugar palm      | Larvae only eat a little and die after 1-2 days with an attack intensity of 3.03% | Do not eat and die after 1-2 days with an attack intensity of 0% |
| Areca nut       | Larvae only eat less and cannot complete their life cycle, larvae die on day 4 with an intensity of attacks of 11.67% | Do not eat and die after 1-4 days with an intensity of attacks of 5% |
| Soybean         | Larvae eat a lot and can complete their life cycle with an attack intensity of 73.80% | Larvae eat a lot and can complete their life cycle with an intensity of attack of 81% |
| Green beans     | Larvae eat a lot and complete their life cycle with attack intensity of 38.53% | Larvae eat a lot and can complete their life cycle with an attack intensity of 40.90% |
| Peanut          | Larvae still eat but not much, and die on day 6th attack intensity of 35.67% | Larvae eat a lot and die on the 6th days with an attack intensity of 76.20% |
| Mucuna bracteata| Larvae eat a lot and can complete their life cycle with an attack intensity of 86.73% | Larvae eat a lot and can complete their life cycle with an attack intensity of 77.30% |

Pests in searching for food are influenced by color, smell, taste, plant texture and environmental conditions. If these factors support the pest will like the plant, but if the above factors do not support the pest will not like the plant. The condition of S. litura larvae original from oil palm applied to coconut plants die faster and attack intensity is very low with percentage 0%. The larval conditions that can last longer with high attack intensity are found in larvae that are applied with M. bracteata plants amount 86.73%.

Palm trees are perennials, these plants are usually cultivated as plantations. When S. litura original from oil palm and soybeans was applied to the forced feed test and select feed test, S. litura only ate a few types of palm trees at low intensity only on oil palm, areca nut and sugar palm. But it is more consuming all legume plants as soybean, mung bean, peanuts and M. bracteata in high intensity. This can be seen from the
percentage of attacks on the forced feed test and feed test treatments of \textit{S. litura} original from oil palm to coconut trees treatment and \textit{S. litura} original from soybean to coconut plants treatments. The absence attacked from \textit{S. litura} comes from oil palm and come from soybeans. Even \textit{S. litura} origin from oil palm and soybeans gradually dies due to lack of food (Table 6).

In other plants test known that larvae do not eat because the leaves have a fairly hard texture and some have a waxy coating so that the larvae do not have the ability to bite and chew the leaf tissue. This is evidenced by the absence of symptoms of damage to the leaves of the test plant. [9] Stated that antixenosis is a process of rejection of plants against insects when the host selection process is hampered by the presence of plant morphological structures such as trichomes on the stem, the presence of a waxy layer on the leaves, and thick and hard skin that acts as a mechanical barrier for insect pests. In other cases of antixenosis are also influenced by chemical compounds that are able to resist insects.

4. Conclusions
\textit{S. litura} is a pest that can attack legume and palmae plants. The preference of \textit{S. litura} original from oil palm on plants test sequentially was \textit{M. bracteata}, soybeans, green beans, peanuts, oil palm, areca nut, sugar palm, and coconut. The preference of \textit{S. litura} original from soybeans on plants test sequentially were soybeans, \textit{M. bracteata}, peanuts, green beans, oil palm, areca nut, coconut and sugar palm.

References
[1] Price P W 2000 Host plant resource quality, insect herbivores and biocontrol Proceedings of The X International Symposium on Biological Control of Weeds 583. 14 July 1999 (Bozeman, Montana: Montana State University) pp 583-90
[2] Ministry of Agriculture Indonesia 2016 Indonesian Plantation Statistics 2014-2016 (Jakarta: Ministry of Agriculture Indonesia)
[3] Bedjo S, Indianti W and Suharsono 2011 The Effect of Vegetable Pesticides, NPV and Strain Resistant to Biological Aspects of Army Worm (Jakarta: Nuts and Tubers Research Center, Directorat General of Plantation)
[4] Untung K 2006 Introduction of Integrated Pest management (Second edition) (Yogyakarta: UGM Press)
[5] Marwoto and Suharsono 2008 Strategies and Components of Technology for Controlling the Armyworm Spodoptera litura in soybean plants Jour. Agri Res Dev 27 4 pp 1-15
[6] Elisa N 2013 Insect Ecology (Yogyakarta: Gajah Mada University Press)
[7] Nurhajijah 2018 Preference and Development of Spodoptera litura in Peanuts, Mineral Oil and Peat Media Plants [Thesis] (Medan: Universitas Sumatera Utara)
[8] Wiyono S 2007 Climate Change and Pest and Disease Explosions (Bogor: Bogor Agricultural University)
[9] Suharsono 2001 Study of the resilience aspects of several soybean genotypes against pod sucking pests \textit{Riptortus linearis} F. (Hem: Alydidae) (Yogyakarta: Gadjah Mada University)