The intensity of major pests on pepper (Piper nigrum) in Tanggamus Regency - Lampung Province

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Abstract. As one of the black pepper production centers in Indonesia, Lampung pepper productivity is quite low compared to other central areas. Lampung produces around 500 kg/ha, quite far from the national average production which is around 796 kg/ha, or even the productivity of other regions such as Bangka-Belitung which has reached 1.2 tons/ha. One of the main problems that cause this is a fairly high pest attack. For this reason, a study was conducted on the intensity of the main pest attack on pepper plants in one of the pepper-producing areas in Lampung, namely Tanggamus Regency. The study was conducted in April-May 2021 by taking 100 plant spots (samples) randomly in the location. The intensity of pest attack is calculated by a scoring system. The results showed that there were three main pests that attacked pepper plants in Tanggamus Regency - Lampung Province, namely the pepper stem borer (Lophobaris piperis) with the intensity of around 38%; Thrips sp. with intensity of about 23% and fruit suckers (Dasynus piperis) with intensity of about 9%.

Keywords: Dasynus, Lophobaris, Plant Damage, Thrips

1. Introduction
Pepper (Piper nigrum L.) is one of worldwide most used spices and consider a spice crop with a high economic value. With an area of 189.703 ha, pepper in Indonesia has an essential role in the national economy, including as a foreign exchange source, a provider of employment, as a raw material ranging from food to pharmaceutical industry [1, 2, 3]. Pepper contains the main active ingredient, piperine, which belongs to the pyridine group [4, 5]. The piperine content in pepper is an average of 6%, but in the form of extract, it can contain 25.74% to 48.32% [6]. Pepper ethanol extract contains high anti-oxidants, which is 74.61% [7]. Pepper can also be used as a natural pesticide [8, 9].

World pepper production and exporters are controlled by several countries, among others are Vietnam, Indonesia, Brazil, and India. Several regions in Indonesia, including Lampung, Bangka, Kalimantan, and Sulawesi have been determined as pepper development areas. Pepper plantations in Indonesia are dominated by small farmers/small holders plantations (96%). The rest is private estate companies. Lampung produces black pepper, while Bangka white pepper. Lampung and Bangka are the primary sources of exported pepper commodities, while pepper from Kalimantan and Sulawesi is mainly used for the domestic market and a small portion is exported [2]. There are several problems in pepper development, such as a) limited adoption of pepper technologies, b) the shortage of suitable
varieties, c) rare partnership between farmers and businessmen, d) yield losses due to pest, e) climate change, and f) world pepper price fluctuation [10]. One of the hot issues in pepper export is the aflatoxin content. The total aflatoxin content of the samples taken from Lampung, Bangka, and Kutai was still categorized under the limits set by BPOM and European Union regulations [11]. This means that the quality of Indonesian pepper is sufficient to meet export standards. The problems faced by pepper farming in Indonesia were mainly the low productivity of pepper (less than 1 ton/ha), for example; productivity in Lampung is about 0.5 ton/ha. Meanwhile, the national average productivity is about 796 kg/ha due to significant yield losses due to pests, resulting in a decline in production and export value [12, 13, 14].

The largest regencies that have the largest area of pepper in Lampung are North Lampung, Way Kanan, West Lampung, Tanggamus, and East Lampung. Tanggamus is a new pepper development area in Lampung [10]. Most of the pepper plantations in Lampung, such as North Lampung and Tanggamus, are cultivated in a polyculture system (pepper-coffee and other cash crops like banana), although sometimes they are managed less intensively [15, 16, 17]. This low pepper plantation management is one of the main reasons for the high pest and disease attacks in Tanggamus. But the pest control measures only can be carried out by identifying the pest first. Therefore, the objective of the research is to observe the intensity of the major pest attack to pepper plantations in the Tanggamus Regency, Lampung Province.

2. Materials and Methods

The research was conducted in April-May 2021 (dry season). As many as 100 samples (pepper plant) were taken randomly in the Tanggamus Regency. Each sample was carefully observed for any symptoms of pest attack. The type of pest is determined the symptoms of pest attacks on plants. The symptoms of pepper stem borer (Lophobaris piperis) can be seen from the yellowing and wilting leaves, then the dredged part of the branches dries up and breaks easily. The fruit-sucking pest (Dasynus piperis) forms black spots on the fruit, makes the fruit becomes empty. Meanwhile, the damage caused by Thrips sp., leaf margin roll upward bend on both sides. Intensity is calculated by the formula below:

$$I = \frac{\Sigma (n \times v) \times 100}{N \times V}$$

(I = intensity; n = number of plants included in a particular symptom score; v = value of certain symptoms; N = number of plants observed; V = highest attack value).

The percentage of the intensity is obtained from the part of the plant that is affected by symptoms and then compared with the whole plant, with the following categories: 0 (no attack); 1 (1 - 15%); 2 (16 - 30%); 3 (31 - 45%); 4 (46 - 60%); 5 (61 - 75%); 6 (76 - 90%); 7 (> 90%).

3. Results and discussion

Several pepper pests were identified, they are L. piperis, D. piperis, and Thrips sp. (Table 1). From these observations, it is also known that in most of pepper plantations in Tanggamus, the farmers still paid relatively low attention (carry out the minimum fertilization, land management, and pest control). This situation makes plant productivity is not optimal. However some research show that the pepper farming is financially profitable and feasible. Research even proves that the application of intensive plant cultivation (including the pest control) can increase the competitiveness of black pepper [18, 19]. This minimum plant management is also one of the causes of the high rate of pest attack.
Table 1. Intensity of pepper main pests in Tanggamus.

| Insect Pest     | Pest Intensity (%) |
|-----------------|--------------------|
| Lophobaris piperis | 38                |
| Dasynus piperis  | 9                  |
| Thrips sp.      | 23                 |

Figure 1. Pepper cultivation with (a) monoculture system and (b) polyculture system in Tanggamus, Lampung.

3.1. Pepper stem borer (L. piperis)
Pepper stem borer (L. piperis) is one of the most detrimental pepper pests in Indonesia and Malaysia. The larvae burrow into the trunk and branches. The initial symptoms are wilting and yellowing of the leaves, then the dredged part dries up and breaks easily. Heavy attacks can cause the plant to die. The mature stage attacks shoot, flowers, and fruit so that the production and quality of the fruit decrease [20, 21, 22]. The intensity of pepper stem borer attack in the field is about 38%. It is quite high, considering the high possibility of pepper harvest loss in the future. In a study in the early 1990s in Sambas, Kalimantan, the attack intensity of pepper stem borer was around 4-7% [23]. The following figures are examples of L. piperis attacks on pepper plants in Tanggamus.
3.2. Fruit sucker (D. piperis)
Fruit-sucking pests (D. piperis) are active in the morning and evening, while during the day, they hide in the interior of the plant canopy. It is usually found when the pepper fruit will be harvested in the canopy of pepper plant. This pest attacks almost all pepper centers in Indonesia and causes fruit damage. This pest is destructive at all stages of growth by sucking fluid from flowers, fruit, young shoots, and petioles. Symptoms of damage in the form of black spots on the fruit, the fruit becomes empty. Furthermore, the young fruits fall so that the fruit bunches become empty (Figure 3) [24, 25]. The intensity of fruit sucker attacks in the field is about 9%. The number is relatively low, comparing to a study in 2004 in Bangka Island where the highest infestation was 36% [24].

3.3. Thrips sp.
Thrips sp. is classified as one of the main pests on pepper plants, not only in Indonesia, but also in other countries like Ethiopia and Bangladesh [21, 26, 27]. It damages shoots, leaves, and flowers by piercing plant tissue and sucking plant sap. The excrement is a growth medium for the fungus, so that
it can interfere with the photosynthesis process of plants. In other plants, *Thrips* sp. can be a more dangerous pest because it can also serve as vectors of plant diseases. Many types of viruses that infect plants are carried by *Thrips* sp. such as Tomato spotted wilt virus, Groundnut ringspot virus, Chrysanthemum stem necrosis virus, Impatiens necrotic ringspot tospovirus, Pelargonium flower break virus, Tomato chlorotic spot virus, Melon yellow spot virus, Watermelon silver mottle virus, and Peanut bud necrosis virus [28, 29, 30]. Even though the evidence of *Thrips* sp. as a vector of pepper plant disease has not been found, it still has to be controlled.

*Thrips* sp. can move from one part of the plant to another by running, jumping, or flying. The ability to fly *Thrips* sp. is feeble, so the transfer from one plant to another is strongly influenced by external factors such as wind. The intensity of *Thrips* pest attack on pepper plants in the field is around 23%, is generally characterized by the number of curled and dry leaves that eventually fall off. The *Thrips* sp. attack on pepper leaves can be seen in the following figures.

![Figure 4. *Thrips* sp. attacks on Pepper plant in Tanggamus, Lampung.](symptoms of severe attack of *Thrips* sp. when the leaves are fully curled up)

Those three pest are the significant production constraints for pepper cultivation. To manage these obstacles, farmers usually using synthetic chemical pesticides. This results in environmental degradation and the presence of pesticides residue, although the residue is still in a low range level or under the detection of equipment so they are considered safe for consumption [31, 32]. However, organic spice production is an important issue nowadays, so safer measure of pest management is important right now. Therefore, the integration of several approaches like the use of suitable varieties, natural enemies, and biopesticides are essential to do. Biopesticides derived from plants (botanical pesticides) such as neem (*Azadirachta indica*), citronella grass (*Cymbopogon nardus*), cloves (*Syzygium aromaticum*), or entomopathogenic fungus like *Beauveria bassiana* have the potential to control those three primary pepper pests [33, 34, 35]. Beauveria has been reported to produce secondary metabolites such as bassianin, bassiacridin, beauvericin, bassianolide, beauverolides, tenellin, and oosporein which can paralyze and cause the insect death [36, 37]. The botanical pesticides also use their secondary metabolites products which functions as a repellent, attractant, and poison as well as antifeedant [38]. These three ingredients (neem oil, citronella oil, and clove oil) are stated by other research as potential biopesticide to control several pests including *Thrips* sp. [39, 40, 41].
4. Conclusion and recommendations
There are three kinds of primary pest attacking pepper in Tanggamus Regency, Lampung. Pepper stem borer (L. piperis) with the intensity of about 38%, fruit sucker (D. piperis) around 9% and Thrips sp. about 23%. Meanwhile, to control those three main pepper pests, the recommendation is the integration of several approaches like the use of suitable varieties, natural enemies, and biocides derived from plants (neem oil, citronella oil, and cloves oil and B. bassiana).

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