

# Phenomenon of Thrips (Thysanoptera) Attack on Chili Plant (*Capsicum annuum* L.)

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**Abstract:** Phenomenon of Thrips (Thysanoptera) Attacks on Chili Plant (*Capsicum annuum* L.). Thrips are insects that damage agricultural plants such as chili plants (*Capsicum annuum* L.). The attacks which was caused by the thrips starting from mild to severe attacks. In Jambi province there was not any report about the attacks phenomenon of thrips on chili plants. The research aimed to analyze the phenomenon of thrips attack on chili plant. The study was conducted by observing the attacks of thrips on the leaves chili plant. First, observations were done on 160 chili plants in the infested cage thrips which obtained from chili plantation, cucumbers and squash. Observations were carried out at the part of affected leaves, color, shape and location of the attack, leaf structure, chlorophyll content and the content of nitrogen, fats and carbohydrates of affected leaves. Besides, tests Elisa was also done on the affected leaves. Second, observations of thrips population and the attack percentage, as well as the abundance of predators were performed on 400 chili plants in the field experiment in Jambi University. The thrips attack was allowed to happen naturally without spraying plants by insecticide. Observations in captivity found that thrips attack occurs on the upper leaf surface, occurs at the base, the middle and the edges with silvery attack. Thrips attacks on chili plant lower chlorophyll content and damage the structure of the leaf cells. Levels of nitrogen, fats and carbohydrates of chili leaf which attacked by thrips were not significantly different from control leaves at the level of 5%. Elisa test results showed that the leaves were attacked by the thrips which derived from chili plantation and host plant do not contain Tosspovirus. Results of research in the field shows that the population of thrips, the percentage of the attack and the abundance of insect predators of thrips fluctuate and the highest is at the age of 8 mst chili plants. There are 15 species of predatory thrips were found in the field experiment of Jambi University. The members of Sphecidae, Araneidae, Theridiidae and Coccinellidae were found mostly.

**Keywords:** Attack Phenomenon, *Capsicum annuum* L. and Thrips

## Introduction

Thrips are a major pest of chili plants. Thrips are polifag, can attack many types of plants, including crop plants. Thrips attack the buds, leaves and flowers of chili plants. Thrips attack on the young leaves and flowers (Kalshoven, 1981). Thrips attacks can cause chili leaf curling to the upward. The attack of thrips on chili plants starts from a mild attack to heavy. Mild attack begins from attack symptoms on leaves marked with silvery white color. Furthermore, the silvery color changed to be

brown. Paroxysm attack occurs when thrips act as vectors of viruses that cause disease in chili (Ananthakrishnan, 1993).

Thrips attack can degrade the quality of agricultural products can reach the half. Thrips attack the buds so that the leaf buds die. At thrips cotton seed meal also in the shoots that grow and can damage the leaves appear. This can lead to distortion of light leaf (1-5 thrips are cropping), severe leaf distortion (there are 5 to 20 thrips are cropping) to cause the death of shoots which causes the plant cannot produce new shoots from the buds

additional elsewhere on the plant (20 + thrips are cropping). Extreme damage can result in yield loss and can be exacerbated by cold weather which further slows plant growth (Williams *et al.*, 2011). Thrips control has been done by spraying using synthetic insecticides periodically. Spraying is done 2x a week, whether it exists or not thrips. This will give rise to adverse conditions, either against natural enemies and the environment. The result will be resurgence, resistance and killing natural enemies. This research can provide the basic knowledge of how attacks thrips in chili so that an input in making effective and efficient control and kinder to the environment.

## Materials and Methods

### *Observations Chili Plants in Confinement*

To analyze the phenomenon of thrips attack on the leaves of chili plants by observation. Observations were carried out in the laboratory Department of Science and Mathematic Education, Faculty of Teacher Training and Education Jambi University, Jambi Indonesia. A total of 160 chili plants be planted in polybag, then each polybag put in the plastic mica cages and smooth gauze pads. Into each cage is released imago of thrips. Thrips which are put in a cage taken from healthy green chili plants (50 cages), yellow was attacked virus (50 cages) and from the host plants are cucumbers and squash (60 cages) (Fig. 1). The observed phenomenon included the attacked plants, color, shape and location of the attack on the plant. Observations on affected leaves done every day for 21 days using a Nikon 40 mm f/2.8g AF-S DX Micro NIKKOR Lens.

### *Analysis of Esophageal Chili Leaves Thrips*

The thrips attacked on leaves of chili plants analyzed, the analysis carried out on; (1) The chlorophyll content of leaves infected chilli thrips by using chlorophyll meter (SPAD), (2) nitrogen, carbohydrate and fat leaves infested by thrips, (3) histological leaves infested by thrips, (4) Elisa test (Enzyme Linked Immunosorbent assay) to the leaves infected chilli thrips derived from chili plants and host plants. Elisa test is performed to determine whether the attack that occurred on the leaves of chili plants was caused by thrips or caused by a virus carried by thrips as vectors. Elisa test used the method of Clark and Adam (1977).

## Results and Discussion

### *Thrips Attack on Chili Plants in Confinement*

#### *Thrips Attack Symptoms*

Thrips attack chili plants by way of sharpening and sucking. Results strewn around the trips activity

sharpening on the upper leaf surface of the chili plant. Then thrips suck networks by immersing the body in powder as the results of sharpening (Fig. 2 and 3). Thrips that attack one chili leaf have varied density. In one attacked chili plant leaf was found one, two, three even more than four individuals in one part of the leaf (Fig. 4). Trips attacked on Chilli leaves colored silvery. Symptoms of thrips attacked on the chili leaves are round, oval, elongated and the shape of the number 8 (Fig. 5).

The thrips attack on chili plant in captivity occurred on the upper leaf surface (Fig. 6), there is also at the top of chili plants. The attack on the leaves of chili plants started from a mild attack to heavy attack. Heavy and light attack symptoms on the leaves were vary in shape (Fig. 7 and 8). The leaves are attacked by thrips also vary, there at the end, base, edge, or in the middle (Fig. 9). The initial attack of thrips was mild shown by former silvery sharpener. Thrips attacks will change with the symptoms on the leaf spotting brownish color (Fig. 10-12).

In Fig. 6 it is known that thrips usually attacks the upper leaves of chili plants or young leaves. This is related to the nitrogen content contained in these plants. Nitrogen content in the upper leaves or shoots and young leaves is higher than the lower leaves. High nitrogen content on the leaves of young shoots or leaves may explain why more thrips populations on young leaves than on the older leaves (Mattson, 1980). Insects will choose the appropriate part of the plant to meet its needs. The food is mainly nitrogen was instrumental in the breeding of insects, especially the effect on the fecundity of female insects (Blum, 1985). At this finding thrips more common than upper leaf shoots, because the leaves on the nymph population is able to accommodate more than the leaf buds, leaf size over broader than leaf buds.

In Fig. 12 it is known that thrips attacks on the leaves of chili plants are marked with a silvery white color, then gradually change to brown. To meet the nutritional thrips sucking the cell fluid causes the cell to become damaged and destroyed (Kirk, 1997). Lewis (1997) reported the attack surface of the thrips resulted in silvery-white leaves, then the leaves dry and turns into brown and eventually fall out. Collapse of the leaf directly related to the physiology that occur on leaves infested by thrips. Trips attacks will spur the production of ethylene, so the affected leaves will fall more quickly. Thrips attack can induce ethylene production which can accelerate aging and damage to plant organs (Childers and Achor, 1995). Childers and Achor (1995) found the tissue attacked by thrips produce ethylene 2.2 times faster than the damage caused by physical factors, the flowers are attacked produce 640 nmol ethylene per gram wet weight per 24 h, compared with 152 nmol healthy flowers. Salivary secretion of eat thrips also causes cell damage is more extensive. Ethylene is also produced by plants as a result of interaction with the saliva secreted by insects (Burden *et al.*, 1989).



Fig. 1. Observations of thrips attacks on chili plants in confinement (a to d)



Fig. 2. Imago and nymphs of thrips that are whitening chili leaf surface. Imago bowed head in powder sharpener (a) the nymph and imago were sharpening chili leaf surface (b)

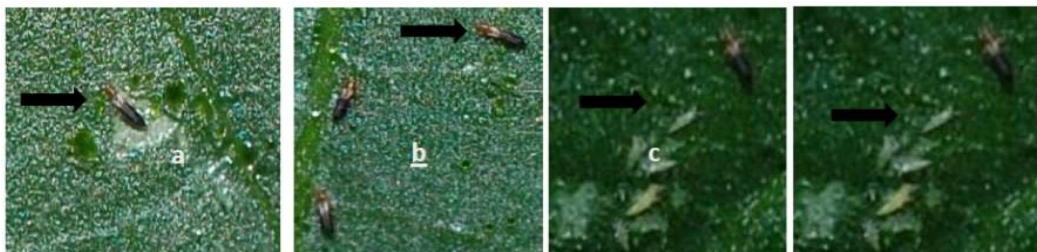


Fig. 3. Density variations chilli thrips that attack the leaves, individually (a), group (b and c)



Fig. 4. Variations chilli thrips attacks on plant leaves are round (a), oval (b) elongated (c) and figure-eight (d)



Fig. 5. Thrips attacking the upper leaves of pepper plants (a, b and c)



Fig. 6. Initial attack symptoms on the leaves of plants chilli thrips (a and b)



Fig. 7. Symptoms of chilli thrips on the leaves brownish (a to e)



Fig. 8. Thrips attack to the base (a, b), middle (c, d) and the thrips of chili leaves (e, f)

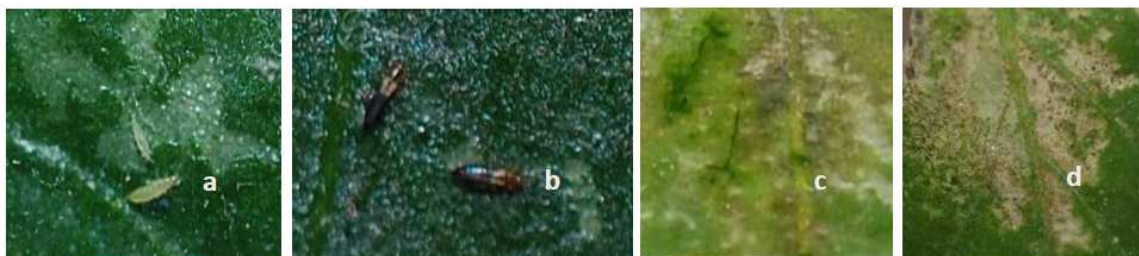


Fig. 9. Color attack of chilli thrips on plant leaves. Silvery attack (a and b) and a brownish color changing attacks (c and d)



Fig. 10. The development of the leaf chili thrips attack. Initial attack (a), widespread attack (b), discoloration attacks (c and d)

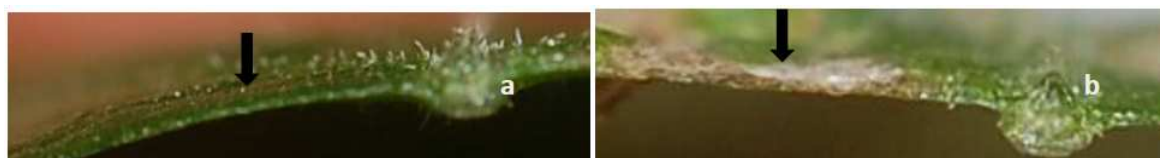


Fig. 11. Leaf cross sections of chili thrips attack. Attacks on the upper surface (a) and attack until the bottom surface (b)

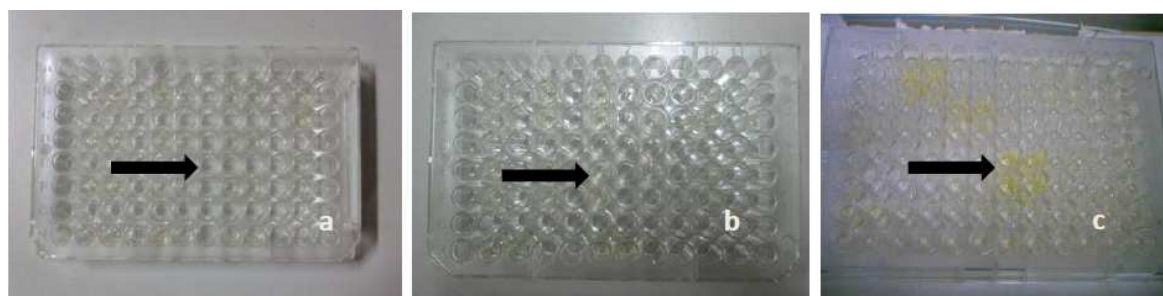


Fig. 12. Elisa test results affected leaves thrips. (a) thrips attacks on the plant chilli (b) thrips attack of the host plant. Color samples tested colorless, negative reaction. (c) a positive reaction (Clark and Adam 1977)

Kendall and Bjostad (1990) also reported that given *T. tabaci* onions produce higher levels of ethylene compared to mechanical damage as a result of artificial onion, because saliva can induce ethylene production of thrips.

In Fig. 5 it can be seen that the form of the thrips attack on chilli leaves plants are varies. The attack is a round, oval, elongated and there is a form the number 8. The signs of feeding on the leaf surface of cereal crops attacked by thrips form a hole like a number of eight (Childers and Achor, 1995). The shape of the hole can be vary depending on the thickness of the leaves were observed. Mandibular stylet helps by piercing the first hole, maxillary stylet widen the holes on the surface, leaving a hole in the form of a Fig. 8 (Kirk, 1997). Kumar *et al.* (1995) also found traces of former thrips feed on leaves with shapes ranging from round, oval, elongated and form a Fig. 8. The figure-eight-shaped hole begins with a single hole, the hole is then extended by the mandibular stylet to pierce the leaves several times in different positions (Kirk, 1997). After eating at one hole, thrips repeat to eat in the same hole or continue

to eat in a new hole. From Fig. 12 it can be seen that there are holes thrips exfeeding were clumped and scattered there. Eating holes grouped together in susceptible cucumber varieties, but when the resistant varieties, the anxiety of thrips appears. Thrips to spend most of the time to walk and eat individually at scattered holes.

#### *Microscopic Structure of Plant Leaves Chili Esophageal Thrips*

The structure of the leaves of chili plants are attacked by thrips analyzed microscopically. As a result of the thrips attack on chilli leaves can cause structural damage to the leaves. Damage starts from mild impairment to severe damage. Heavy damage is resulting the cell destroyed. Thrips eats the contents of the epidermis, palisade and spongy mesofil cells, resulting in cell wall or cell collapse destroyed the contents scattered cells (Kirk, 1997). There are two types of eating thrips on the leaves of the plant that is the eating process with short duration and shallow burial in a long duration.

Table 1. The content of nitrogen, carbohydrates and fats in the leaves of pepper plants are attacked by thrips in the 1000 mg

The content	leaves infected	leaves control
Nitrogen (N)	139,56	140,07*tn
Fat	162,04	167,88*tn
Carbohydrate	255,46	261,92*tn

Description: \* tn = not significantly different at 5% level

Table 2. Leaf chlorophyll content before and after the chilli thrips attack

Statistical Indicators	Chlorophyll content (mg/L)	
	Before developing	After suffering
Average	41.58	38.24*
Standart deviation	4.73	4.76

Description: \* = significantly different at 5% level

Ingestion shallow with short duration, the damage is limited to the cells of the epidermis and some adjacent mesophyll cells, whereas the long duration of burial in the damage extends deeper into the mesophyll cells and possibly to the vascular tissue (Harrewijn *et al.*, 1996). Thrips stylet penetration depth varies throughout the funeral of a few micrometers to about 60  $\mu$ m. Variations in the depth and breadth of eating is reflected in the time spent in each hole eating, which range from a few seconds to over an hour. Heming (1978) reported Phlaeothripids have a stylet that can reach further so tend to eat much longer on a single hole. Old eating Haplothrips verbasci may take more than one hour. The depth of injury in various tissues citrus plants in the epidermal layer ranges from 12-20  $\mu$ m and 20-84  $\mu$ m expanded into a network (Childers and Achor, 1991).

#### Nitrogen, Carbohydrates and Fats Leaf Chili Esophageal Thrips

The leaves of chili plants are attacked by thrips analyzed nitrogen content, carbohydrates and its fat. Chili leaves were analyzed were affected leaves thrips of more than 50%. The results of the analysis of nitrogen, fat and carbohydrates t test at 5% level. T test results showed that the levels of nitrogen, fat and carbohydrate were not significantly different between leaves infected with leaf that is not affected (Table 1).

#### Elisa Test Leaf Plants Attacked Chili Thrips

To find offensive thrips attacked on chilli leaves of the plant contain a virus or not, the Elisa test was done. Elisa test results diseased leaf thrips collected from the chili crop is negative (Fig. 12). This means that the attacks were not contained Tospovirus. TSWV is the only member of the group of tomato spotted wilt virus plant virus and is only transmitted by thrips and *T. parvispinus* do not transmit Tospovirus (Ullman *et al.*,

1995). Riley *et al.* (2011) added that of the 1,710 species of Thripidae only 14 species currently reported thrips transmit Tospovirus. *T. parvispinus* not included in the 14 species. From Fig. 12 also known that thrips attacks obtained from the host plant cucumber and squash also contains no Tospovirus. The results of the identification of existing thrips in cucumbers and squash the time treatment that is found *T. parvispinus* and *T. palmi*. This indicates that in Jambi Province Tospovirus not found. Currently the status of the species *T. palmi* as thrips vector is still unclear (Riley *et al.*, 2011).

#### Chlorophyll Levels Chili Leaves Esophageal Thrips

Chlorophyll levels leaves affected by thrips was measured by chlorophyll meter SPAD-502 Plus brand. Measurements were taken before and after treatment (Appendix 4). The results of measurements of chlorophyll content is known that the chlorophyll content of leaves infested by thrips lower than non-infested leaves ( $\leq$  5%) (Table 2). To get the nutrients thrips stick stilet into the leaf tissue and suck the liquid epidermis, palisade containing chlorophyll and mesophyll cells (Kirk, 1997). Kolb *et al.* (1991) Rereporting five adult thrips per bud in confinement will cause chlorosis. Damage caused by feeding thrips cause high loss water rate. Leaves infested by thrips tend to experience water stress and reduce the rate of photosynthesis in conditions of low water availability (Kolb *et al.*, 1991). Thrips attacks can reduce the rate of photosynthesis by 20% (Ellsworth *et al.*, 1995).

#### Conclusion

Thrips attacks on the chili plants leaves occur on the upper leaf surface at the base, middle, or at the edge of the leaf. Thrips are investing leaves of chili plants occur individually, or in groups. Thrips attacked on Chilli leaves are round, oval, elongated and form a figure eight with the silvery color of the attack, then change color to brown. Thrips attacks on the chili leaves of the plant can reduce the chlorophyll content of leaves and damage the cell structure of chili. Levels of nitrogen, fat and carbohydrates of attacked leaved are not significantly different from non-infested leaves at 5% level. Elisa test results to the thrips attacked on chili leaves do not contain Tospovirus.

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## Author's Contribution

**Asni Johari:** Contributed to all experiments, coordinated the data-analysis and contributed to the writing of the manuscript.

**Siti Herlinda:** Contributed to designed the research plan. Make in drafting the article or reviewing it critically for significant intellectual content.

**Chandra Irsan:** Contributed to coordinated the data-analysis and make in drafting the article or reviewing it critically for significant intellectual content.

**Yulia Pujiastuti:** Contributed to coordinated the data-analysis and make in drafting the article or reviewing it critically for significant intellectual content.

## Ethics

The authors state that this article is in accordance with the ethical standards specified by American Journal of Agricultural and Biological Sciences.

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