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Study of Plant Pest Organisms in Maize-Edamame Intercropping

Siti Afiyana Damayanti[1], Mahindra Dewi Nur Aisyah[1], Iqbal Erdiansyah[1], Christa Dyah Utami[1]

[1] *Food Production Technology, Department of Agricultural Technology, State Polytechnic of Jember, Indonesia*

Correspondence should be addressed to:
Mahindra Dewi Nur Aisyah
afiyanadamayanti03@gmail.com

Abstract:
The problem of maize-edamame cultivation is inseparable from the attack of plant pest organisms. Another alternative control is needed, one of which is the intercropping. This study aims to observe pests that attack glutinous maize and edamame plants. This research was conducted from June to September 2024 on farmland on Kebonsari, Sumbersari District, Jember Regency. The experimental design used was by comparing polyculture and monoculture planting patterns consisting of 4 treatments. The results showed the presence of pests and diseases, namely aphids (*Aphis glycines*), green looper (*Chrysodeixis chalcites*), asian maize borer (*Cercospora sojina*), stem borer (*Ostrinia fumacalis*), southern rust (*Puccinia sorghi*) and or maize smut (*Ustilago maydis*).

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INTRODUCTION

Indonesia is an agrarian country that relies on the agricultural sector as a source of daily livelihood. Commodities grown in Indonesia vary in type and play an important role, including maize and edamame plants. According to data from the Central Statistics Agency (2023), East Java and Central Java are the primary centers of maize crop production in Indonesia. This is based on data from the last 4 years. According to Wibowo et al. (2020), in 2017, PT Mitratani Dua Tujuh Jember produced 9,000 tons of edamame on a land area of 1,500 hectares, with 85% of the production exported to various countries, including Japan, Europe, Kuwait, Malaysia, Australia, and the United States.

There are two cropping patterns: monoculture + polyculture. Monoculture is a method of cultivating plants by planting a single type of crop on a single land area. while polyculture is the planting of more than one type of plant on a farm (Syahputra et al., 2017). Other than that, the most important thing to consider is the symptoms of pest organisms. Constraints can take the form of diseases, pests, and weeds that can reduce plant productivity to the point of crop failure. Therefore, it is necessary to implement effective and integrated plant control through intercropping systems and the use of repellent plants. A polyculture system is a plant cultivation system that utilizes multiple types of plants planted simultaneously, thereby increasing land use efficiency and reducing pest attacks. According to Rizka et al. (2015), intercropping systems can reduce pest populations due to visual disturbances by non-host plants that which can affect the behavior and speed of insect colonization on host plants. According to Prasetio (2022), the use of intercropping can suppress pest growth because pests that attack one commodity can become predators for other plant pests.

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A polyculture of maize and edamame is suitable for a combined cropping system (Aminah et al., 2014). Aisyah and Herlina (2018) provide several advantages, including being able to reduce pest attacks. Other efforts that can be made to reduce pest populations are the use of repellent plants. Repellent plants are plants that have secondary metabolite compounds that can resist pest attacks, such as basil and lemongrass. Basil plants are known to have a pungent aroma that can repel insect pests (Mulyadi et al., 2017), whereas citronella is both antifeedant and repellent (Supriyatni et al., 2023). This research is to observe how organisms attack the maize and edamame plants.

METHOD

This research was conducted from June to September 2024 on farmland in Kebonsari, Field Sumbersari District (8º11'30.5" S and 113º42'46.5" E). The climate of Jember Regency is tropical, with a temperature range of 23 °C to 32 °C. The tools used in this research are kenco, tugal, hoe, koret, meter, knapsack, paddle, bucket, scales, sickle, camera, and stationery. The materials used were maize seeds Kumala F1, edamame seeds Biomax 1 variety, 416 basil seeds, 288 lemongrass seeds, manure (1 ton/ha), water, NPK 15-15-15 (350 kg/ha), urea (300 kg/ha), liquid smoke 2L, and copper oxide (5 g/15L).

This research design compares polyculture and monoculture, consisting of four treatments: P1 = Polyculture of glutinous maize and edamame; P2 = Polyculture of maize and edamame with lemongrass border plants; P3 = Polyculture of maize and edamame with basil border plants; and P4 = Maize Monoculture. Observations were carried out on plants aged 2 WAP (Weeks After Planting) until harvest time. Observations were made once a week in the morning, from 06:00 to 09:00.

RESULTS

Plant Pest Organism

The symptoms found in various maize-edamame cropping patterns include aphids, green looper, Asian maize borer, stem borer, southern rust, and maize smut. The attack symptoms of these various pests can interfere with plant growth and cause crop damage. Various pests exhibit specific symptoms that affect plants.

Table 1. Pest organism

No	Organisms			
	Edamame		Maize	
	Pest	Diseases	Pest	Diseases
1	Aphids *(Aphis glycines)*	Frogeye leaf spot *(Cercospora sojina)*	Asian maize borer *(Ostrinia fumacalis)*	Southern rust *(Puccinia sorghi)*
2	Green looper *(Chrysodeixis chalcites)*			Or Maize smut *(Ustilago maydis)*

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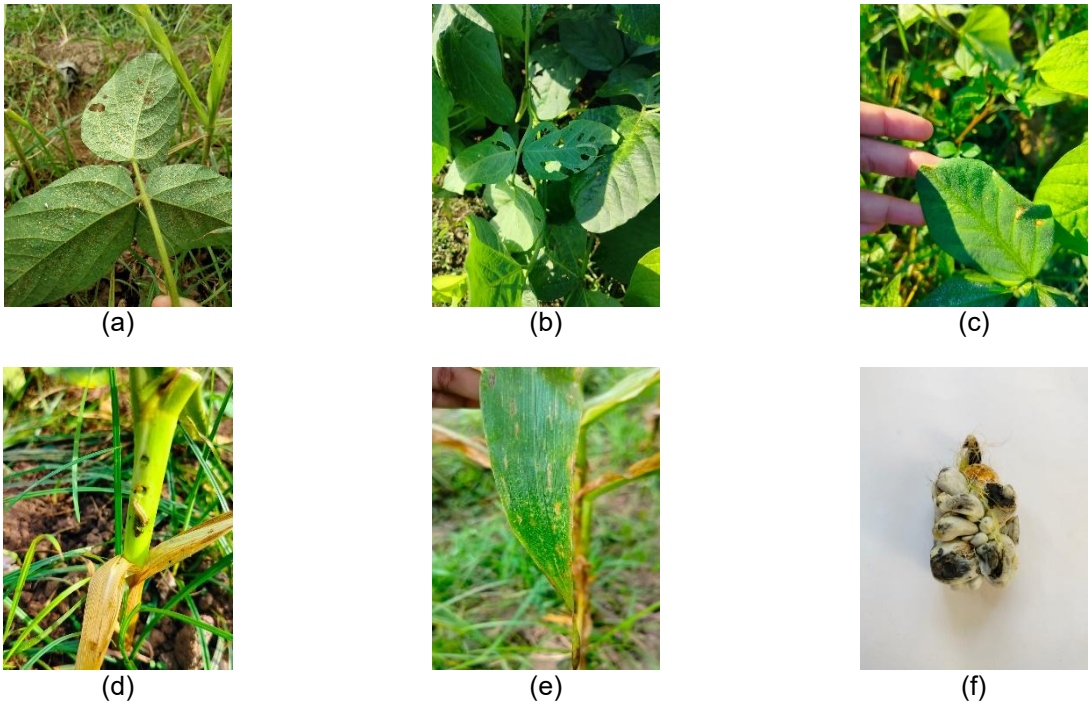

Figure 1. Aphids (a), green looper (b), frogeye leaf spot (c), asian maize borer (d), southern rust (e), and or maize smut (f)

DISCUSSION

Aphids (*Aphis glycines*)

Aphids are one of the pests that cause problems for edamame plants. Aphids dwell under the surface of the leaves in groups and have mouthparts such as piercing and sucking. The body character of aphids is winged, pear-shaped, with a length of approximately 1.5 mm (Voegtlin et al., 2004, as cited in Said, 2014).

Symptoms of aphid attack are leaves that become curled, wrinkled, and die. Aphis also often attacks flowers and pods. Severely attacked plants will produce yellowish leaves, be stunted, experience abnormal growth, and lose vigor. Aphid attacks generally start from the lower leaf surface, plant shoots, flower buds, and young stems (Anggraini et al., 2018). Factors that influence the development of aphids are caused by an increase in ambient temperature, which is directly proportional to the increase in the speed of the pest's metabolic process. It can be inferred that when the temperature increases, the metabolic process of aphids will accelerate (Agastya et al., 2020).

Green looper (*Chrysodeixis chalcites*) (lepidoptera: Noctuidae)

Chrysodeixis that attacks edamame on the leaves. The body of the chrysodeixis is green with bright white lines on the sides. The chrysodeixis breed faster and hatch within a maximum time of 3-4 days. Chrysodeixis attacks plants in the vegetative to generative phase. The chrysodeixis eats the leaves from the edges and lays eggs on the lower surface of the leaves. Larvae attack the leaves by leaving small holes like windows. Heavy attacks on adult chrysodeixis usually eat the leaves until they are not left and leave only leaf twigs, which occurs in the phase of edamame plants at pod filling (Adolph, 2016).

Generally, the upper part of the leaf is the first target of the chrysodeixis when it attacks. These pests start attacking when the plants are 10 days old, and on the leaves of edamame, Chrysodeixis

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eggs can already be seen. Chrysodeixis attacks both the leaves and pods of edamame. Leaves that have been bitten by chrysodeixis will look hollow, leaving only a small stem of the leaf. Chrysodeixis are known as polyphagous pests, meaning they can feed on all parts of the edamame plant. They eat the leaves from the edges and lay eggs on the underside of the leaves. The pest has a fast life cycle, with eggs hatching within 3 to 4 days. Chrysodeixis has three phases of attack, starting with the first attack when the chrysodeixis is 10 HST, the second attack at 25 HST, and the third attack when the chrysodeixis reaches 35 to 40 HST (Adolph, 2016).

Frogeye leaf spot (*Cercospora sojina*)

Spot disease is also known as target spot, caused by the fungus Corynespora cassiicola, which infects young plants until pod filling. Typical symptoms of the disease include circular spots with a clear concentric center line (Inayati & Yusnawan, 2017). The spots are reddish-brown in color, with a diameter of 10-15 mm, and sometimes have a circular shape, like on a shooting board. Early symptoms of target spot disease typically appear as small, light brown spots on the leaves. As the disease progresses, the spots will enlarge and form a target pattern, characterized by a dark brown center surrounded by light brown rings. Infected leaves may dry, peel, or turn yellow and eventually fall off. Environmental factors such as high humidity, warm temperatures, and high plant density can influence the development of this disease (Adolph, 2016).

Asian maize borer (*Ostrinia fumacalis*)

Ostrinia fumacalis is one of the pests that attack maize crops, specifically targeting the stems. Its larvae make tunnels inside the stems by gnawing on the tissue, which serves as their food source. The tunnels made by stem borers can make the plant susceptible to pathogens and cause it to rot at the end of the season. Ostrinia fumacalis is a pest that attacks maize plants in the vegetative to generative phase. The generative phase is the most vulnerable phase (Bato et al., 1983, in Pratama et al., 2015).

According to Pangumpia et al. (2019), this type of pest attacks maize plants starting from the vegetative to the generative phase. Damage to leaves and male flowers is caused by instar I, II, and III larvae, while instar IV and V larvae attack maize stalks to cobs. There is severe damage resulting in broken stalks that cause obstructions in the flow of nutrients. The larvae undergo five instar stages, each varying in size. For instance, I, the length is 1-3 mm with an average size of 1.40 mm. Instar II has a size range of 3.50-5 mm, with an average of 4.30 mm. Meanwhile, instar III measures 7-12 mm with an average of 9.10 mm. For instar IV, the length ranges from 13-20 mm with an average of 17.20 mm. Finally, instar V has a size of 16-24 mm with an average size of 21.50 mm (Mulia, 2016).

Southern rust (*Puccinia sorghi*)

Leaf rust disease in maize plants is caused by the fungus Puccinia sorghi, characterized by the presence of small, yellow-brown spots resembling rust. According to Syarifudin et al. 2018, the symptoms of leaf rust disease are small spots (uredinia) in the form of round to oval shapes found on the surface of the upper and lower maize leaves. Uredinia produce uredospores, which are round or oval and play a crucial role as a source of inoculum for infecting other maize plants, spread by wind. Puccina sorghi is one of the most important diseases in Indonesia. The first sign of a rust-affected maize plant is the appearance of ulcers on the top and bottom of the leaves, with a reddish-brown color spread over the leaf surface. After teliospores develop, their color changes to brownish black (Burhanuddin, 2015). Leaf rust disease causes the inhibition of the photosynthesis process, resulting in stunted plants and decreased production or, in some cases, no production at all

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(Prasetyo et al. 2017). Rust disease in maize is classified into three types: southern maize rust, common maize rust, and tropical maize rust. This fungus attacks maize plants after the milk ripening phase (Hamidson et al. 2017).

Or maize smut (*Ustilago maydis*)

Or maize smut in maize is caused by the fungus Ustilago maydis, which causes swelling on the cob, resulting in damage to the maize and a decrease in yield. Ustilago maydis attacks plants in the cob formation and seed filling phases. Factors that influence the development of this disease are high temperature and humidity. The main symptoms are found on the cob. Infected kernels swell, forming glands. Initially, the glands are white, then black, with clear skin. Some glands are visible from the outside until they burst, scattering black fungal spores (Syarifudin et al., 2018).

CONCLUSION

There are 6 Organisms that attack Maize-edamame crops, consisting of aphids (Aphis glycines), green looper (Chrysodeixis chalcites), frogeye leaf spot (Cercospora sojina), Asian maize borer (Ostrinia fumacalis), Southern rust (Puccinia sorghi), and maize smut (Ustilago maydis).

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