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Response of Three Sweet Maize Varieties to Leaf Blight (*Exserohilum turcicum*) Planted in Freshwater Swamps of South Sumatra

Respons Tiga Varietas Jagung Manis terhadap Penyakit Hawar Daun (*Exserohilum turcicum*) *yang Ditanam di Tanah Rawa Sumatera Selatan*

Rafika Oktarida[1], Harman Hamidson[2*)]

[1]Plant Science Study Program, Faculty of Agriculture, Universitas Sriwijaya, Palembang 30139, South Sumatra, Indonesia
[2]Department of Plant Pests and Diseases, Faculty of Agriculture, Universitas Sriwijaya, Indralaya 30862, South Sumatra, Indonesia
[*)]Corresponding author: harmanhamidson@fp.unsri.ac.id

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ABSTRACT

Penanaman varietas tahan merupakan cara pengendalian yang paling efektif dan dianjurkan karena aman bagi lingkungan. Masalah yang ingin diangkat pada penelitian ini adalah penggunakan satu varietas jagung yang sama disetiap musim tanam oleh petani. Penggunaan satu varietas tersebut dapat menyebabkan penurunan hasil akibat patahnya ketahanan varietas terhadap hama dan penyakit tertentu. Penelitian ini bertujuan untuk memberikan informasi berupa penggunaan varietas jagung manis yang tahan terhadap penyakit hawar daun yang potensial ditanam di rawa lebak Sumatera Selatan. Varietas yang digunakan dalam penelitian ini adalah varietas Bonanza F1, MB-01 Sweet dan Love Sweet. Berdasarkan hasil penelitian secara keseluruhan penggunaan beberapa varietas berpengaruh nyata terhadap keparahan penyakit hawar daun. Hasil penelitian ini menunjukkan bahwa adanya perbedaan respon ketahanan setiap varietas terhadap penyakit hawar daun yang disebabkan oleh jamur *Exserohilum turcicum*. Pengamatan keparahan penyakit dilakukan hanya pada fase vegetative. Keparahan penyakit tertinggi ditemukan pada varietas Bonanza yaitu 16,90%, varietas Love sweet sebesar 9,99% dan pada varietas MB-01 Sweet yaitu 7,07%. Produksi menunjukkan pengaruh tidak nyata terhadap penyakit hawar daun. Varietas MB-01 Sweet berpotensi untuk ditanam pada tanah rawa karena memiliki ketahanan terhadap penyakit hawar daun dan memiliki tingkat produksi yang tinggi.

Kata kunci: *Zea mays* Saccharata Sturt L, varietas jagung, penyakit hawar daun (*Exsrohilum turcicum*)

ABSTRACT

Planting resistant varieties is the most effective control method and is recommended because it is safe for the environment. The problem to be raised in this study was the use of the same variety of maize in every growing season by farmers. The use of one of these varieties could cause a decrease in yield due to the resistance of the variety to certain pests and diseases. This study aimed to provide information in the form of the use of sweet

maize varieties resistant to leaf blight and potential to be planted in the swampy lowland of South Sumatra. The varieties used in this study were Bonanza F1, MB-01 Sweet and Love Sweet varieties. Based on the results of the study, as a whole the use of several varieties had a significant effect on the severity of leaf blight. The results of this study showed that there were differences in the response to resistance of each variety to leaf blight caused by the fungus *Exserohilum turcicum*. The observation of disease severity was carried out only in the vegetative phase. The highest disease severity was found in the Bonanza, Love Sweet, and MB-01 Sweet varieties at 16.90%, 9.99% and 7.07% respectively. The production data showed that there was no significant effect on the leaf blight. The MB-01 Sweet variety had the potential to be planted on swampy soil because it had resistance to blight and had a high production rate.

Keywords: *Zea mays* Saccharata Sturt L, maize varieties, leaf blight disease (*Exsrohilum turcicum*)

INTRODUCTION

South Sumatra is a province that contributes to national maize production. This maize production can be increased through extensification by planting maize on sub-optimal land such as swampy lowland (Yasin, 2013). Ogan Ilir is the largest swamp area in South Sumatra with an area of 266.607 ha (Ratmini & Herwenita, 2014). Swampy lowland is that having a certain period of waterlogging (Margono et al., 2016). The period of inundation/wet swampy lowland occurs from February to December while the dry period occurs from June to October (Itoh et al., 2017). The maize plants can be planted in swampy lowland when the water starts to recede from June/July to October (Herwenita & Hutapea, 2018).

Selection of suitable varieties for planting on sub-optimal land is another effort that can be used to increase the productivity of sweet corn in swampy lowland (Hutasoit et al., 2020). According to Khairiyah et al. (2017), the Bonanza F1 variety planted on swampy lowland gives high yields. The availability of varieties that can adapt and provide good yields in an area causes farmers to always use the same variety every growing season. The use of one variety of maize planted continuously on a large scale can cause pathogens to adapt well and be able to detect with high intensity. There are several diseases that often attack maize cultivated in swampy lowland including leaf rust, stem rot, ustilago and leaf blight (Hamidson et al., 2019). The maize leaf blight caused by the fungus *Exserohilum turcicum* is one of the important diseases of maize because it can cause losses of up to 50% (Tuszahrohmi et al., 2019). The high yield losses can occur if pathogenic infection occurs before the maize silking stage (Tajudin et al., 2018).

Management practices that are effective and can reduce the impact of blight are selecting resistant varieties (Jakhar et al., 2017). Handling blight using resistant varieties is the most effective strategy (Ahangar et al., 2016) and is recommended because it is safe and does not pollute the environment (Latifahani et al., 2014). For this reason, this study aimed to provide information in the form of the use of sweet maize varieties resistant to leaf blight which are potential to be planted in the swampy lowland of South Sumatra.

MATERIALS AND METHODS

The study was carried out from August to December 2019 in the Agrotech Training Center (ATC) research area, the Faculty of Agriculture, Universitas Sriwijaya (Figure 1), and the Phytopathology Laboratory of the Department of Pests and Plant Diseases, Faculty of Agriculture, Universitas Sriwijaya. The research method used a Completely Randomized Design (CRD) consisting of 3 treatments and were

repeated 7 times in order to obtain 21 experimental units.

Cultivation of Maize

The planting medium used swampy lowland soil in the Agrotech Training Center (ATC) research area, Faculty of Agriculture, Universitas Sriwijaya. The soil was sieved to separate it from weeds, rocks and wood. Then the soil was mixed with chicken manure and put in a poly bag measuring 40 × 40 cm. The poly bags already filled with soil were neatly arranged on a provided plot with a distance of 1 × 1 m and labeled according to the research layout.

The polybags already filled with the media were poured with water until reaching the field capacity so that the soil was completely wet up to the water coming out of the polybag holes and were left for 3 days before planting. The maize seeds used in the study were Bonanza-F1, MB-01 Sweet and Love Sweet varieties. The plant maintenance was carried out by watering, controlling weeds, and applying fertilizers. Watering was conducted every day, morning and evening depending on the environmental conditions and soil moisture. Weed control was done manually by removing the weeds growing around the plants. The nitrogen fertilizer was given at the 4^{th} week after planting with the recommended dose of 300 kg/ha (Pusparini et al., 2018) so that the dose per polybag was 0.75 g/polybag.

Inoculum Preparation and Inoculation Techniques

A survey was conducted to several farmers' sweet maize fields. The maize leaves that had leaf blight symptoms were taken from the farmer's land and the microscopic observation and identification were carried out to find out the pathogenic species. Preparation of the suspension follows the method of Gowda et al. (Gowda et al., 2012) by collecting the heavily infected leaves with a severity of ≥ 30%, cut into small pieces and suspended in sterile water. The density of spores used 103 conidia per ml of sterile distilled water. The inoculation was done artificially by spraying the suspension using a hand sprayer at a dose of 10 ml/plant at the age of 21 DAP (Tuszahrohmi et al., 2019). The inoculation was carried out in the dusk.

Observation of the Leaf Blight

The observation of the incubation period was carried out every day after the inoculation until the first symptoms appeared. The obtained data were used as supporting data in determining the resistance of the variety. The severity of the disease was found out by calculating the progression of the spots by measuring the length and width of the spots. The observation of the disease severity was carried out only in vegetative or only until the tasseling phase (male flowering) with intervals of once every four days. According to Akonda andHossain (Akonda & Hossain, 2015), the formula for spot development was as follows:

$$\text{Spotting Development} = \frac{\text{Spot Area}}{\text{Leaf area}} \times 100\%$$

The environmental conditions such as temperature and humidity were measured using a Thermohygrometer which was carried out every day of observation by placing the Thermohygrometer in the middle of the experimental field to find out the environmental factors influencing the disease progression. The harvesting was conducted in the morning when the plants were ± 70 DAP, and was carried out on each plant. The harvested corncobs were then weighed.

Data Analysis

The obtained data were tested using the F test at 5% level and further tests were carried out using the DSH (Difference Significant Honest) test to determine the effects among the treatments.

Figure 1. Research location

RESULTS

E. Turcicum has conidia shaped almost like a tube/cylindrical, slightly curved, has a bulkhead and there was a part that protrudes at the end of the conidia called the hilum. Early symptoms of maize leaf blight caused by *E. turcicum* begin with the appearance of yellowish green spots elongated parallel to the leaf bones. The color of the spots turns brownish. In the center of the patch becomes necrotic as the spots increase in size. At high humidity the center of the spots will look like black flour (Figure 2). Based on the field observations, the three tested maize varieties showed symptoms of leaf blight on days 7 to 14 days after inoculation (Table 1).

Table 1. Incubation period for leaf blight

Variety	Average (Day)
Love Sweet	8.71
Bonanza F1	6.71
MB-01 Sweet	14.86

The symptoms of leaf blight that appeared the fastest were in those of the Bonanza variety after 6 days of the first inoculation and the longest symptom occurred was in the MB-01 Sweet variety after 14 days of the first inoculation. This indicates that the level of resistance of the Bonanza variety was lower against the leaf blight.

Based on the observations, the severity of the disease showed that there were differences in each variety. The results of analysis of variance showed that the treatment of maize varieties had a significant effect on the severity of leaf blight. The disease severity showed an increase in daily severity and the highest progression of disease severity occurred in the Bonanza variety, at the 10th observation it reached 16.90%, the Love sweet variety reached 9.99% and the MB-01 Sweet variety reached 7.07%. (Figure 3).

Temperature and humidity could affect the development of a disease. In the 6th and 9th observations there was a decrease in temperature due to rain causing high humidity. The average condition of the environment during the observation was 25.9°C with an air humidity of 85.3% (Table 2). The yield calculation was carried out at the age of the plants ready for harvest. Based on the results of the analysis, the results were not significant. The highest corncob weight was in that of the Bonanza variety and the lowest was in that of the Love Sweet variety (Figure 4).

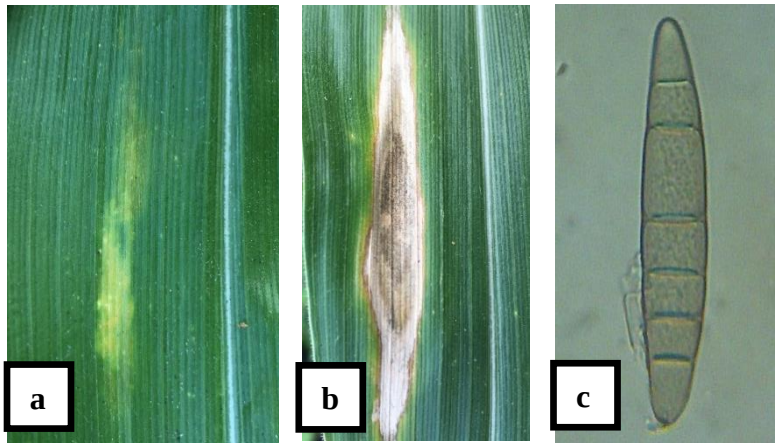

Figure 2. Symptoms of maize leaf blight. Initial symptoms (a). Symptoms continued after 17 his b). conidia *Exserohilum turcicum* c)

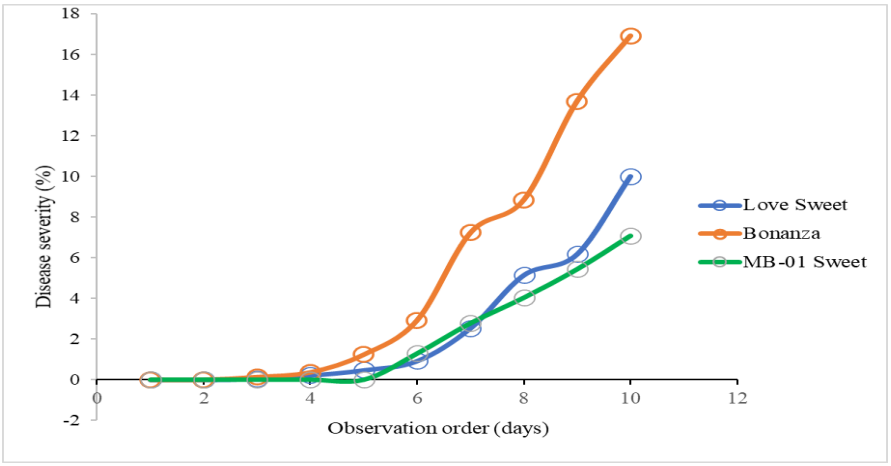

Figure 3. Development of leaf blight at each observation

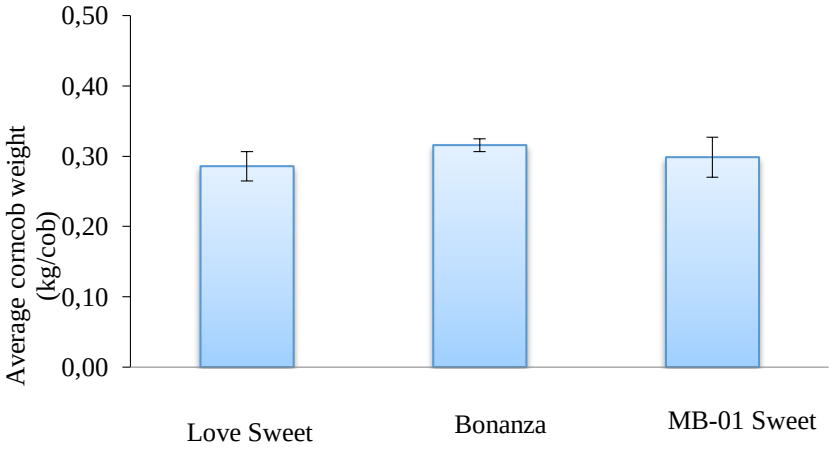

Figure 4. Average corncob weight in each variety

Table 2. Conditions of temperature and humidity in the morning during the observation

Environmental Factor	Observation Order (days)										Average
	1	2	3	4	5	6	7	8	9	10	
Temperature (°C)	26	27	28	26	27	22	26	28	23	26	25.9
Humidity (%)	84	85	82	83	85	92	84	82	93	83	85.3

DISCUSSION

Early symptoms of maize leaf blight caused by E. turcicum began with the appearance of yellowish green spots elongated parallel to the leaf bones. The color of the spots turned brownish. In the middle of the spots went through necrosis along with the increasing size of the spots. At high humidity the center of the spot looked like a black powder which was a collection of pathogenic spores. Around the spot there was a yellow halo caused by the development of pathogenic hyphae in the leaf tissue by producing toxins that could interfere with the function of chloroplasts, causing a reduction in leaf chlorophyll content. Kotze (Kotze, 2020) state that *E. turcicum* has monocerin toxin which can interfere with chloroplast function.

Based on the observations results, there were differences in disease severity in each treatment. The lowest average disease severity was found in the MB-01Sweet variety indicating that the MB-01 Sweet variety was more resistant than the other two varieties. This was indicated by the number of spots that appeared on the MB-01 Sweet variety less than on the other varieties. This is presumably because the MB-01 Sweet variety has polygenic resistance which can control the number of spots that arise. The symptoms of *E. turcicum* leaf blight can develop for 7-12 days after inoculation (Kutawa et al., 2017). In the MB-01 Sweet variety, the pathogen incubation period occurred 14 DAI. According to Latifahani et al, (2014), a high incubation period means that the intensity of leaf blight attacks is lower. In the Bonanza variety, the incubation period is faster, namely 6 DAI. The rapid incubation period causes disease severity in the high Bonanza variety. This proves that the faster the pathogen incubation period was, the higher the severity of leaf blight will be.

Plant diseases can occur when there are interacting supporting factors for disease development such as virulent pathogens, susceptible plants and a supportive environment. The attack of leaf blight continues to increase every day. Based on the results of the field observations, the highest increase in damage began to occur on 7, 9 and 10 observations. This was influenced by the environmental conditions in the form of temperature and humidity that supported disease development. According to Reddy et al. (2014), *E. turcicum* grows well at 25-30˚C. On the 6th day of the observation, it rained which caused the temperature to be low, namely 22^0C and 92% humidity which supported the development of leaf blight to be rapid so that at the time of the 7th observation with a span of 2 days of observation, there was an increase in disease severity, as well as in observations 9 and 10. This proves that the increase in the severity of leaf blight was greatly influenced by the environmental factors. The increase in the intensity of leaf blight is strongly influenced by the nature of the susceptibility or resistance of the variety and the environmental conditions conducive to disease development in the field (Tajudin et al., 2018). In the dry season, the blight rarely causes large yield losses, but during the rainy season, the disease can cause yield losses of more than 50%, especially if the first attack occurs before male flowers appear (Talanca & Tenrirawe, 2015). Based on the data of the yield, each variety had no significant effect on the weight of corncobs. However, the severity of leaf blight caused only one corncob to develop completely, while the other cobs failed to develop. The failure to develop corncobs is thought to be caused by the severity of leaf blight which continues to increase every day. The increasing width of

the spots causes the leaves to become damaged so that it has an impact on the photosynthesis process which causes the plant to lack nutrients during the seed filling period. The weight of corn cobs is also determined by the high photosynthate due to the photosynthesis process that is

running well (Reyna et al., 2020). This proves that the large size of leaf spot due to *E. turcicum* can reduce photosynthate which results in decreased yield.

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