

Distribution and level of damage by basal stem rot disease (*Fusarium oxysporum f sp cepae*) on shallots in West Sumatera

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Abstract. Basal stem rot disease caused by *Fusarium oxysporum f sp cepae* is an important disease in shallots and causes yield losses to 50%. This study aims to determine the distribution of the disease and calculate the level of damage by disease on shallots in West Sumatra. The study used a survey method with sample areas in three districts with shallot production center. In each district, the seven sub-districts with the highest shallot cultivation area were selected. Sampling was taken in each sub-district using a purpose random sampling method, with the criteria being that there were symptoms of the disease, and the plants were 1 – 2 months old. Observations were made of the symptoms, the incidence and severity of the disease. The results showed that basal stem rot disease was found in three shallots center areas in West Sumatra, namely Solok, Agam and Tanah Datar districts with disease incidence ranging from 1.02 % – 42.89 % and disease severity of 19.20 % – 35%. Based on macroscopic and microscopic identification, the pathogen that causes BSR disease is *Fusarium Oxysporum*.

1 Introduction

Shallots (*Allium ascalonicum L.*) are horticultural crops that have many benefits and high economic value. One of the important diseases in shallots is Basal Stem Rot (BSR) disease (in the local language called "moler") which is caused by *Fusarium oxysporum f.sp cepae*. (FOCe). Yield losses due to BSR disease can reach more than 43% depending on senvironmental conditions [1]. The disease intensity of BSR in Brebes, Centrel Java were varies from 0 to 75% which significantly affects yield losses. Yield losses of same shallot plantings are over 50% [2].

In the field, the first symptom emerges as warping, yellowing and dieback of leaves. Rot and Red-brown discoloration expand at the margin of the root-basal supplate, and bulbs and

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stems get reddish-purple discoloration as the *Fusarium* ties up from the plate into scales. With the progression of the disease, the whole plant can crumple [3,4]. There were also variations of symptoms in the leaf growth. Leaves' length growth abnormally, become much longer, but flat and thick (normal leaves are shaped like a pipe), do not grow upright but wriggle, and the color of leaves is pale green or yellowish [5].

West Sumatra is one of the centers for shallot cultivation in Indonesia. The three districts that are centers for shallots in West Sumatra are Agam, Solok and Tanah Datar districts. The incidence and severity of BSR disease in this area has never been reported. However, symptoms of the disease have been found in the field. Mariani et al. [6]'s research disclosed that all shallots in West Nusa Tenggara were affected by moler disease, with an average incidence rate of 64.71%, primarily caused by *Nectria haematococca* [6]. Meanwhile, Wibowo *et al.* [7] observed shallot farming practices in the Bantul coastal area, noting that during the rainy season, Samiran sub-village had the highest disease incidence at 33.97%, whereas during the dry season, Depok sub-village experienced a 20.14% incidence rate. Sono sub-village exhibited the lowest disease rates, at 12.44% and 0% during the rainy and dry seasons, respectively. The aim of the research is to determine the distribution of the disease and calculate the level of damage by disease on shallots in West Sumatra.

2 Materials and methods

2.1 Field survey

The survey was conducted in three shallot cultivation center districts in West Sumatra, namely Agam, Solok and Tanah Datar districts. In each district, the seven sub-districts with the highest shallot cultivation area were selected. The sampling was taken from 14 Nagari using a purpose random sampling method, with the criteria being that there were symptoms of the disease, and the plants were 1 – 2 months old. Observations were made of the symptoms, the incidence and severity of the disease. Plants with disease symptoms are collected and taken to the laboratory for isolation of the pathogen. Determining the level of damage in the field is done by calculating the incidence of disease and the severity of the BSR disease. The formula used is [8],

$$P = \frac{a}{b} \times 100\% \quad (1)$$

P = incidence of disease

a = number of infected plants

b = number of plants observed

Disease severity was determined by a 0 - 5 visual scale (where, 0: no disease; 1: > 0 – 20% Number of symptomatic leaves; 2: > 21 - 40% Number of symptomatic leaves; 3: > 41 – 60 % Number of symptomatic leaves; 4: > 61 – 80 % Number of symptomatic leaves; 5: > 81 – 100 % Number of symptomatic leaves [9].

$$I = \frac{\sum (ni \times vi)}{Z \times N} \times 100\% \quad (2)$$

I = Severity of disease

n = number of leaves on the same scale

v = scale value for each category of disease symptoms

Z = the highest disease scale value

N = number of leaves observed

2.2 Identification of the pathogen

Isolation of pathogen using the direct planting method, samples of symptomatic bulbs were washed with tap water, then cut into small pieces, the bulbs pieces were sterilized with 70% alcohol solution and 1% NaCl solution and rinsed with sterile distilled water. Next, the tuber pieces were placed on PDA (Merck) media in a petri dish and incubated for 7 days at room temperature [10]. Purification of pathogenic fungi is carried out by culturing on PDA media in sterile petri dishes. Identification is carried out by observing the macroscopic and microscopic characters of purified fungi. The macroscopic characters observed were the color and shape of the colony, the microscopic characters observed were the shape of the conidia (macroconidia and microconidia) and fungal chlamydospores. Identification refers to Leslie & Summerell [11].

2.3 The pathogenicity test

Pathogenicity test was carried out on 4-week-old shallot of the Bima Brebes variety which were planted in polybags with sterilized soil. Inoculation was carried out by immersing 10 g of rice substrate containing FOCE culture into the soil to a depth of 3 cm around the roots of the shallot. Initial symptoms appeared 15 days after inoculation. Initial symptoms include leaves twisting, the color of the leaves becoming pale green or yellowish (Fig. 1) [12].

3 Results and discussion

3.1 Distribution and level of damage

Based on field surveys, symptoms of BSR disease were found in 14 Nagari in three districts in West Sumatra, namely Agan, Solok and Tanah Datar. Symptoms in the field are leaves grow abnormally, twist, pale green to yellowish, and wilt (Fig. 1). At the tips of the leaves there are necrotic, there are also rot on shallot bulbs. According to Herlina, *et al.* [5], there are variations in the symptoms of BSR disease in shallots, including abnormal leaf growth, pale green to yellowish leaf color, plants not growing upright and rotting on the bulbs.

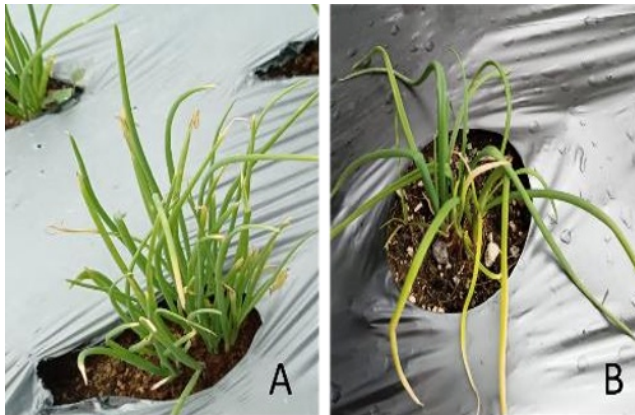


Fig. 1. The symptom of BSR disease on shallots, (A). Pale green and yellowish leaves, (B). Abnormally leaves growth and wilt.

Table 1. Distribution, incidence and severity of BSR disease on shallots in West Sumatera.

| District | Sub-district | Nagari | Incidence (%) | Severity (%) |
|-----------------------|----------------|-------------------|---------------|--------------|
| Agam | Ampek Angkek | Biaro | 4.45 | 19.20 |
| | | Lambah | 2.21 | 22.40 |
| | Baso | Koto Gadang | 10.51 | 21.60 |
| | | Koto Baru | 8.47 | 24.00 |
| Average | | | 6.41 | 21.80 |
| Solok | Gunung Talang | Aia Batumbuak | 1.02 | 27.20 |
| | | Batang Barus | 2.24 | 24.00 |
| | Danau Kembar | Simp.Tj.Nan Ampek | 1.79 | 25.65 |
| | | Kamp.Baru Dalam | 1.83 | 23.20 |
| | Lembah Gumanti | Alahan Panjang | 4.03 | 24.80 |
| | | Sungai Nanam | 2.99 | 21.60 |
| Average | | | 2.32 | 24.41 |
| Tanah Datar | X Koto | Koto Baru | 1 0.98 | 20.00 |
| | | Aia Angek | 42.89 | 20.00 |
| | Batipuah | Bungo Tanjung | 11.01 | 24.00 |
| | | Tanjung Barulak | 6.94 | 35.00 |
| Average | | | 17.96 | 24.75 |
| Average West Sumatera | | | 8.11 | 23.65 |

Based on field observations, BSR disease in shallots has been distributed at 14 Nagari in West Sumatra with varying levels of damage. The incidence of BSR disease in West Sumatra ranges between 1.02 % and 42.89 % and severity of BSR disease range between 19.20 % and 35 %. The highest disease incidence is in Aia Angek and the highest disease severity in Tanjung Barulak, The two Nagari are in Tanah Datar district (Table 1).

Distribution of BSR disease in West Sumatra is due to several factors including shallot cultivar, cultivation techniques, and environmental factors. farmers use susceptible cultivars, do not practice crop rotation and have a monoculture planting system. As a result of interviews, farmers use pesticides intensively to control pathogens in shallots. The farmers play an important role, particularly as the influencer for varieties planted, and plant growth condition is considered an important factor [2]. The farmers are expected to determine the environmental condition through culture practices, including the execution of plant rotation, organic fertilizer and pesticide application [13].

Environmental factors also support the development of disease. survey area is highlands with high temperature, humidity and rainfall. These conditions are suitable for the development and spread of pathogens. Primary inoculum of FocE in *Allium* spp. Based on macroscopic and microscopic identification, the pathogenic fungus of BSR disease is *Fusarium oxysporum* (Fig. 2) often originates from soil and seeds [4]. Under favorable environmental conditions, inoculum can infect and colonize the host, resulting in disease symptoms. Infection and disease development are favored by high humidity and temperatures, with an optimum temperature of 28–32 °C [14].

3.2 Identification of pathogen

Based on macroscopic and microscopic identification, the pathogenic fungus of BSR disease is *Fusarium oxysporum*. Macroscopic and microscopic characteristics of pathogenic fungi (7 days after incubation on PDA media) fungal mycelium is white, slightly yellowish, fibrous like cotton and slightly rough. Colonies are white, but at the bottom the colonies gradually change to yellowish or cream to light purple under certain [15]. According to [16], the color of *F. oxysporum* colonies varies quite widely between species, or also within the same species. Changes and differences in colony color depend on the age of the culture. Young cultures have white colonies. When the culture is mature, the characteristic color of each *F. oxysporum* will appear and change color to purple, white, gray, or sometimes light brown.

Microscopically, macroconidia are crescent-shaped with sharp ends, divided into 3-5 septa. Microconidia are round, ovoid kidney, and lancet in shape. The hyphae are septate and branched. At the end of the hyphae there are round chlamydospores. can be seen in (Fig. 2).

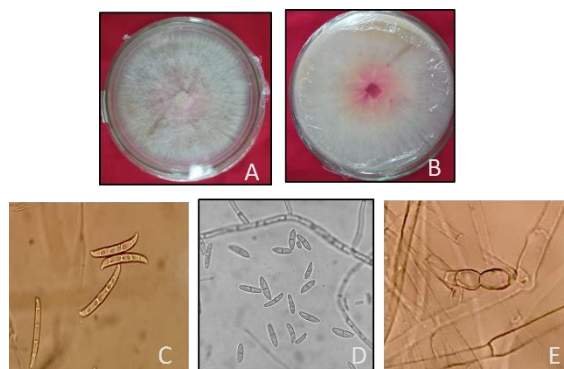


Fig. 2. Characteristic macroscopic and microscopic *Fusarium oxysporum f.sp cepae* (14 days after incubation) in PDA medium. A.Morphology on top view of the colony, B. Morphology on bottom view of the colony, C. Macroconidia, D. Microconidia, E. Chlamydospores (400x magnification).

3.3 Pathogenicity test

Seven days after inoculation of the fungal pathogen, the initial symptoms were pale green leaves turning yellow (Fig. 3). Further symptoms are that the leaves grow abnormally, and the plant does not grow upright. These symptoms are the same as those found in the field. This proves that the fungus isolated from plants with BSR symptoms in the field is the fungus that causes BSR disease in shallots. Pathogenicity trials were conducted on shallots crop under controlled conditions to complete Koch's postulates. These assays were able to identify virulence differences among the *Fusarium* species identified as being the causal agents of the

disease. The pathogenicity assays also proved to be a diagnostic tool for determining the degree of sensitivity of different cultivars to the disease [16].

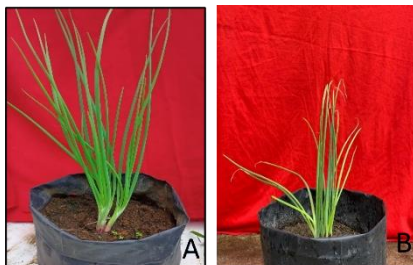


Fig. 3. Pathogenicity test on shallots A. Without inoculation with FOCe B. Plants inoculated with FOCe, there are primary symptoms of pale green to yellowish leaf color.

4 Conclusion

The Basal Stem Rot disease was found in three shallots center areas in West Sumatra, namely Solok, Agam and Tanah Datar districts with disease incidence ranging from 1.02 % – 42.89 % and disease severity of 19.20 % – 35%. Based on macroscopic and microscopic identification, the pathogen that causes BSR disease is *Fusarium Oxysporum*.

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