Distribution of narrow brown leaf spot disease of rice 
(*Cercospora oryzae* Miyake) in North Sumatra

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Abstract. Narrow brown leaf spot (NBLS) disease is an important disease in rice plants in Indonesia and other rice-producing countries in Asia. This disease has been reported as one of the main diseases of rice in rice-producing countries, including in Indonesia. This research was aimed to determine the distribution of narrow brown leaf spot disease which is caused by fungal pathogen *Cercospora oryzae* Miyake in North Sumatra. This research was conducted by survey method which calculated the disease incidence and disease severity of disease in rice plants in seven regions in the province of North Sumatra. The results showed that the disease intensity. The highest disease incidence and disease severity of NBLS disease was found in Siabal Abal Village, Sipahutar District of North Tapanuli with 100% of disease incidence and 95% of disease severity.

1. Introduction

Rice (*Oryza sativa* L.) is a very important food crop in the world after wheat and corn. Rice is a very important food crop because rice has been used as a staple food for most of the world's population, especially in Asia [1]. Rice plant can be affected by several plant pathogens including bacteria, viruses, nematodes, and fungi. Each symptom of a disease that arises may be one of the diseases while there are many symptoms of plant diseases that can be identified and sometimes it is too late to be handled causing crop failure [2].

Narrow brown leaf spot (NBLS) is one of the important diseases of rice plants caused by the fungus *Cercospora oryzae* Miyake. This disease is a very harmful disease, especially in rain-fed rice fields that are deficient in potassium. The decrease in yield due to this disease is caused by the drying of the leaves prematurely [3]. Plant age influences pathogen attack. Old leaves of rice plants are more susceptible to NBLS disease than younger leaves. Increased infection on old leaves can be caused by the translocation of nutrients that have been divided, because nutrients are prioritized for panicle formation [4]. Humidity and availability of light also affect the development of the disease. The process of fungal sporulation is increased in the leaves during prolonged humid conditions [5]. The growth of fungi is slow in dark condition, because the fungus needs light in activating reactive oxygen which is toxic to the host plant [6].

The infection of *C. oryzae* results in the appearance of elongated lesions with dark edges with a grayish centre [7]. Symptoms of NBLS disease usually appear at the time of the rice crop before harvest which is about 11-12 weeks after planting. The initial symptoms of the emergence of narrow and elongated patches with a position parallel to the bone leaf. The patches are approximately 5 mm
long and 11.5 mm wide. The spots are reddish brown. *C. oryzae* can survive in straw or leaves of diseased plants. [8].

NBLS spread throughout rice-producing countries in Southeast Asia, Japan, China, the United States, Central America and Africa. In Indonesia the narrow brown spot disease is spread throughout the rice-producing areas in Java and causes a yield reduction of 30-40% [9].

This research was aimed to determine the distribution of NBLS caused by the fungal pathogen *Cercospora oryzae Miyake* in seven regions in North Sumatra.

2. Material and methods

2.1. Determination of research locations

The research location was determined intentionally (purposive sampling) in seven locations in North Sumatra. Determination of the location of the study was determined based on data searches from the Central Statistics Agency to obtain a description of the location to be surveyed and information from the local community, namely 1) Sukamaju Village, Sunggal District of Deli Serdang, 2) Rawang Panca Arga Village, Asahan, 3) Sumber Tani Village, Talawi District of Batu Bara, 4) Saribujawa Village, Dolok Pangaribuan District of Simalungun, 5) Siabal Abal Village, Sipahutar District of North Tapanuli, 6) Huta Bagasan Village, Dolok Sanggul District of Humbang Hansundutan, and 7) Lumbanlobu Village, Porsea District of Tobasa.

2.2. Sampling method

Sampling in the field is done by modifying several methods. Samples are taken diagonally which starts from an angle towards the opponent forming two diagonal grooves. One diagonal groove contains 12 plots, each measured 1 X 1 M (consisting of 16 rice groves) [10].

2.3. Observation of disease incidence and disease severity

Observation of disease incidence and disease severity was carried out on the number of plants per clumps in each small plot by looking at the visual symptoms. The disease incidence and disease severity were calculated using the formulae:

\[
DI = \frac{a}{b} \times 100\%
\]  

\[
DS = \frac{\sum (n \times v)}{N \times Z} \times 100\%
\]

DI: The incidence of the disease;

a: The family is attacked;

b: Total clumps observed; [11]

The percentage of disease severity can be calculated using the formula:

DS = Disease severity
n = Number of leaves infected by certain categories;
v = Scale value of each infection category;
N = Number of observed leaves;
Z = Highest scale value;
n = Number of observed plants [12]
2.4. Interview
Direct interviews with farmers were conducted to find out some information related to the land to be observed. Information in the form of land area, age of plant or plant phase, number of plants per clumps per small plot, number of plants per plots.

3. Results and discussion

3.1. Disease incidence
All plants in each location observed had symptoms of narrow brown leaf spot disease. The initial symptoms of the emergence of narrow and elongated patches with a position parallel to the bone leaf. The patches are approximately 5 mm long and 11.5 mm wide. The reddish brown spots. (Figure 1) [11].

Figure 1. Symptoms of narrow brown leaf spot disease caused by Cercospora oryzae in four locations North Sumatra (a) in Hutabagasan village (b) in Lumban lobu village (c) In Saribujawa village (d) In Siabal Abal village

Table 1. Disease incidence of narrow brown leaf spot disease caused by Cercospora oryzae Miyake in seven regions in North Sumatra (%)

| No | Location | Rice variety | Average of disease incidence (%) |
|----|----------|--------------|----------------------------------|
| 1  | Suka Maju Village, Sunggal District, Deli Serdang | IR64 | 23.0 |
| 2  | Rawang Panca Arga Village, Asahan | IR64 | 13.0 |
| 3  | Sumber Tani Village, Talawi District, Batu Bara | Ciherang | 97.0 |
| 4  | Saribujawa Village, Panribuan District, Simalungun | Ciherang | 97.0 |
| 5  | Siabal Abal Village, Sipahutar District, North Tapanuli | Br. Tambun | 100.0 |
| 6  | Hutabagasan Village, Dolok Sanggul District, Lumban | Siharompang | 97.0 |
| 7  | Lobu Village, Porsea District, Tobasa | Arias | 98.0 |

Table 1 shows the results of disease incidence of NBLS disease in seven regions in North Sumatra. The highest percentage of disease incidence of NBLS was found in Siabal Abal vilage, Sipahutar of North Tapanuli (100%), followed by Lumban Lobu Village, Porsea district of Tobasa (98%). The lowest percentage of disease incidence was in Rawang Panca Arga Village, Asahan with 13% of disease incidence. This is because the factors that cause the emergence of early symptoms of the
disease in the vegetative phase are planting rice in unison so that the source of inoculum is available around the rice planting area. Environmental factors influence the growth of susceptible rice plants and create conditions suitable for the life of pathogens that cause narrow brown spots. Support from the microclimate (rainfall, soil, water, light and nutrients) and host plants are prone to cause the development of pathogens to infect rice plants in the early vegetative phase, characterized by the presence of narrow brown patches of disease [13].

Percentage of different disease events at each location. This is caused by the presence of environmental factors in each region that give rise to different symptoms (Table 1). Environmental factors such as temperature and humidity conditions, support from microclimates (rainfall, soil, water, light and nutrients) and susceptible host plants cause the development of pathogens to infect rice plants at the beginning of the vegetative phase, characterized by the presence of narrow brown patches of symptoms [13].

Based on observations made in the field, it was found that the reactions caused by plants in each location showed different responses (Figure 1). It is assumed that there are different varieties in each location, giving rise to different resistance [14].

3.2. Disease severity
The disease severity of NBLS disease observed in seven locations in North Sumatra was observed and calculated using formulae and categorized using the disease scale [14] (Table 2, Fig 2).

The highest percentage of disease severity was found in Siabal Abal village, Sipahutar Subdistrict, North Tapanuli Regency with 93% of disease severity, followed in Sumber Tani Village, Talawi District of Batubara with 60% of disease severity. The lowest percentage of disease severity was found in Suka Maju village, Sunggal District of Deli Serdang (5%). This is because environmental factors influence the spread of disease, the influence of wind and friction between leaves [15]. Generally, NBLS disease develops better in the dry season. Although it is not yet known exactly which varieties are resistant and susceptible to this disease, the reality on the ground often shows very diverse reactions.

Table 2. Disease severity of narrow brown leaf spot disease caused by *Cercospora oryzae Miyake* in seven regions in North Sumatra (%)

| No | Location                                      | Rice variety | Average of disease severity (%) |
|----|-----------------------------------------------|--------------|---------------------------------|
| 1  | Suka Maju Village, Sunggal District, Deli Serdang | IR64         | 5.0                             |
| 2  | Rawang Panca Arga Village, Asahan              | IR64         | 10.0                            |
| 3  | Sumber Tani Village, Talawi District, Batu Bara | Ciherang     | 60.0                            |
| 4  | Saribujawa Village, Pantribuan District, Simalungun | Ciherang     | 25.0                            |
| 5  | Siabal Abal Village, Sipahutar District, North Tapanuli | Br. Tambun   | 93.0                            |
| 6  | Hutabagasan Village, Dolok Sanggul District, Lumban | Siharompang | 42.0                            |
| 7  | Lobu Village, Porsea District, Tobasa          | Arias        | 16.0                            |

The disease severity of similar rice varieties, such as IR64 in Suka Maju Village (Deli Serdang) and Rawang Panca Arga Village (Asahan) and Ciherang in Sumber Tani Village (Batu Bara) and Saribujawa Village (Simalungun) showed different percentage of disease severity (Table 2) because
the rice has different resistance genes. The disease is strongly influenced by the type of rice. Ciherang, IR 64 varieties and their derivatives in the field often show very susceptible reactions to NBLS pathogen. Nutrient content especially nitrogen and potassium is very influential in the development of this disease. Rice plants that lack nitrogen and potassium are more susceptible to NBLS disease [16].

![Map of Sumatra showing disease prevalence](image)

(a) Deli Serdang; average of disease severity: 5.0%
(b) Simalungun; average of disease severity: 10.0%
(c) Batu Bara; average of disease severity: 60.0%
(d) Asahan; average of disease severity: 25.0%
(e) North Tapanuli; average of disease severity: 93.0%
(f) Humbang Hasundutan; average of disease severity: 42.0%
(g) Tobasa district, Porsea; average of disease severity: 16.0%

Figure 2. Prevalence of narrow brown leaf spots disease on rice in North Sumatra

4. Conclusions
The highest disease incidence and disease severity was found in Siabal Abal Village, Sipahutar District of North Tapanuli Regency with 100% of disease incidence and 93% of disease severity. The disease severity of similar rice varieties, such as IR64 in Suka Maju Village (Deli Serdang) and Rawang Panca Arga Village (Asahan) and Ciherang in Sumber Tani Village (Batu Bara) and Saribujawa Village (Simalungun) showed different percentage of disease severity.

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