Moler Disease of Shallot in the Last Three Years at Brebes Central Java: The Intensity and Resulting Yields Losses is Increasing

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Abstract. Shallots are one of the important commodities in Indonesia, and have become a mainstay for farmers in certain areas. This is due to the high economic value, short life, and an average harvest time of only two months. In addition, Brebes district, Central Java is one of the production centers, and farmers here have complained about an increasing disturbance and attacks in recent years. This condition is observed in the form of pathogen Fusarium oxysporum f.sp. cepae, responsible for twisting leaf symptoms, and popularly termed “moler” disease. Moreover, Indonesian references show reports on the predominance from the 1970’s, with the name “busuk umbi” Fusarium. This disease is attributed by many others as the basal plate rot, and is estimated to be important in various shallot producing countries. The paper reports on the attack state within the last three years were based on a direct survey of farmers in Brebes. This was conducted with 35 respondent farmers at 7 sub-districts of shallot production centers. The results show a gradual increased in disease intensity and the resulting yield loss within the last three years. In addition, moler intensity was higher in the rainy season, and inappropriate cultivation practices are were estimated as one of the important driving factors.

1. Introduction
Shallot (Allium cepa var. ascolonicum) is an important horticultural commodity in Indonesia, and national stocks availability significantly influences the price fluctuation. Therefore, efforts to ensure consistent supply is a gradually increasing challenge, due to the linear increase in demand with population growth in Indonesia. In addition, horticultural commodity are popularly known to have high risk of pest attack, and plant disturber organisms are one of the constrain during shallot development. The farmers at Brebes, Central Java have complained about an increase in disease intensity within the last several years. Hence, the manifestation is termed “Moler disease” based on the symptoms characterized by twisted or curved leaves. This development usually occurs in late-growth shallot plants, featuring early or temporary wilting at daytime, followed by recovery at night, where the leaves continuously grow elongated. However, a return to the stand position is considered impossible due to twisting.

Conversely, severe disease intensity is characterized by immediate and permanent wilting on the upper part of the plant. This is due to disturbances at the roots or base, estimated to rot extensively, and consequently hinder the function. This includes the ability to absorb water from the soil and translocate to the plants’ upper part [1], [2], [3]. In addition, moler diseases, also known as basal plate rot is initiated by the pathogen Fusarium oxysporum f.sp. cepae (Hanzawa) Snyder & Hansen (FOCe). This manifestation has been reported in Indonesia, although the intensity has never effected significant damage on produce. The identification based on Haryono’s Book was as the Fusarium wilt of shllot
Therefore, the aim of this current paper is to report the disease intensity of moler disease in shallots, and consequently the yield losses incurred.

2. Methodology
The survey was performed from August to September 2020, using a questionnaire containing questions about the intensity of moler disease within the last three years. In addition, data were collected both during the dry and rainy seasons, as well as the yield losses resulting from the attack. The results were all presented in percentage (%). The questionnaires were delivered to shallot farmers in Brebes Regency as respondents. Therefore, a total of seven sub-districts were selected, with Brebes as the largest criteria for production area. A total of about 5 farmers were selected at each location, and the total respondents per district was 35. The data obtained were then presented in graphics.

3. Results and Discussion
3.1. Disease Intensity
Figure 1 shows an increasing trend for the disease intensity of moler at rebes within the last three years. In addition, plant resistance and pathogen virulence, environmental condition were determined to be the epidemiologically important determinant factors [5]. The farmers play an important role, particularly as the influencer for varieties planted. Moreover, some prefer growing genetic susceptible or resistant types, and plant growth condition is considered an important factor. This is because development deficiencies instigated by improper culture practices tend to ultimately induce susceptibility to infection. Meanwhile, weak pathogens, including *Fusarium oxysporum* are more virulent to fragile plants. Hence, the contamination rate is increased on feeble as well as infertile plants.

The farmers are expected to determine the environmental condition through culture practices, including the execution of plant rotation, organic fertilizer and pesticide application [6]. In addition, increased frequency of moler diseases is possibly explained based on the farmers’ choices. Therefore, it is important to evaluate the culture practices conducted at Brebes. However, global warming impact is another possibility to be considered [7], [8], [9], as changes in Temperature conditions potentially favor the development of different pathogens, and further promote plant disease epidemic. The climate culture practice has a tendency to instigate a warmer temperature, and the conditions possibly influence the growth stage, development rate, and virulence of pathogen. Furthermore, this circumstances also alter the physiological process effecting host plant resistance [10].

![Figure 1. The average disease intensity of moler in dry season and rainy season within the last three years](image)

3.2. Yield Losses
The survey results in Figure 2 and 3 showed high correlation between Moler disease intensity and yield losses, due to the pathogen infection [5]. In addition, variety resistance was determined as one of important factors, based on the negative association with both parameters, while the susceptible level is positively related. In addition, yield losses significantly varied in resistant, moderate, and
susceptible varieties [11]. The character genetic resistance also impacts on disease intensity, as samples with the horizontal form tend to be more medium than the vertical variant. This phenomenon results in a more moderate yield losses compared to the susceptible types [12].

The farmers’ estimation were based on the experience during the previous seasons, with no direct access to the real facts. In addition, disease intensity was more affiliated with the incidence than severity, although both have different affect on yield losses. Specifically, the latter is more accurate during assessment, as the incidence only estimates the amount of diseased plants and disregards the infection level or severity [13], [14]. The Moler appears on plants at 30-35 days after planing, and not all lose the capacity to produce yield, as shown in Figure 1 and 2. In addition, the yields losses is generally lower than disease intensity.

Figure 2. Disease intensity of basal plate rot and yields losses based on 34 respondent farmers

Figure 3. Correlation linear regression of disease intensity versus yield losses of shallot

3.3. Discussion

The significant increase in moler disease on shallots at Brebes within the last three years is attributed to improper plant cultivation. This study showed at least three influential items, including continuous cultivation on the same land, incessant fungicide applications, as well as farming without organic matter.
In addition, continuously planting without any crop rotation facilitates the propensity for strong selection pressure on certain pests. This further leads to dominance for the specific commodity and control related challenges. The advent of crop rotation reduces pest selection pressure as well as the chances of dominance. However, at alternating varieties is the least permissible action performed on instances where rotation is impossible [15], [16], [17].

Similar with continuous planting, the continuous application of certain fungicides provides strong selection resistance to certain pests. Furthermore, synthetic fungicide application ought to be avoided, in accordance with the concept of sustainable agriculture. This is due to the obvious negative impact, including environmental damages following the annihilation of beneficial soil microbiota. However, this challenge is possibly overcome by applying natural fungicides. Also, another means to limit the negative impacts include through knowledgeable fungicide application, and by rotating the chemicals used based on active component [18], [19], [20].

The introduction of organic matter to crops is also very important, resulting from the tendency to improve the soil properties, both physically, chemically and biologically. These materials tend to stimulate soil biota biodiversity, ensures the ecosystem (especially the rhizosphere) stability, and facilitates “health” [21], [22], [23], [24].

4. Conclusions

The results show a gradual increase in disease intensity and the resulting yield loss within the last three years, especially during the rainy season. Furthermore, inappropriate cultivation practices are estimated to be an important driving factor at Brebes Central Java. This potentially alters the environmental conditions, and results in favorable circumstance, alongside disease development. Hence, further study is strongly recommended to evaluate culture practices related to the increasing Moler at Brebes.

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