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Full Length Article

Incidence and Severity of Purple Blotch of Onion (*Allium cepa*) in Burkina Faso and Farmers' Perception

Harouna Sawadogo[1], Kouka Hamidou Sogoba[1,2], Kalira Nadège Pioupare[1], Dadjata Kéré[1], Mohamed Sana[1], Alassane Ouattara[1*] and Kadidia Koïta[1]

[1]*Laboratoire Biosciences, Université Joseph KI-ZERBO, 03BP 7021 Ouagadougou 03, Burkina Faso*
[1,2]*Centre Universitaire de Manga, Université Norbert ZONGO, Koudougou, BP 376, Burkina Faso*
[*]For correspondence: alassane.ouattara@ujkz.bf
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Abstract

Onion is grown intensively in Burkina Faso for its economic importance. Unfortunately, it is attacked by various fungal diseases. One of these diseases is the onion leaf spot, which has a real impact on the production. The aim of this study was to analyze producers' perceptions and to assess the incidence and severity of onion purple blotch in different cultivating areas of Burkina Faso. To achieve this, surveys were carried out in 54 fields, which were spread over six provinces in the Sudanian zone, with nine fields per province. In each selected field, three quadrats were placed on the diagonals and all the onion plants were observed. Disease incidence and severity were assessed in each quadrat and producers' perceptions were analyzed by interviewing the owners of the selected onion farms using a questionnaire. According to producers, the disease was attributed to five causes viz. overharvesting, insects, humidity, seeds and winds. The results showed that the incidence and severity of purple blotch of onion were relatively high in all the provinces. The highest average incidence (62%) was observed in Oubritenga province and the highest average severity (49%) was recorded in Kourweogo province. Symptoms of onion purple blotch were observed on all varieties cultivated by the producers. The study also showed that farms using mineral fertilizers had the highest incidence rate of 72%, compared to the use of organo-mineral fertilizers with rate of 44%. Onion yield losses due to disease highlight the urgent need to development of an effective and sustainable control measures.

Keywords: Burkina Faso; Incidence; Producers' perceptions; Purple blotch of onion; Severity

Introduction

Vegetables contribute significantly to the fight against poverty and the challenge of food insecurity in Burkina Faso Ojiewo *et al*. (2015). Among the diversity of vegetables produced; onion is the most important crop. The major bulb onion producers in West Africa are Niger, Nigeria, Senegal and Burkina Faso (Schmelzer *et al.* 2013). However, the crop is subjected to cryptogamic diseases. A study by Dabiré (2017) revealed that the two main fungal diseases devastating onion in Burkina Faso are the purple blotch disease caused by *Alternaria porri* and the onion basal rot caused by *Fusarium* species at vegetative stage.

Purple blotch of onion is one of the most destructive foliar diseases and is widespread in all *Allium*-growing countries of the world (Kareem *et al*. 2012). The disease symptoms begin with small, sunken and oval spots soaked with water on older leaves. As the disease progresses, lesions enlarge, become elliptical to oblong then brown to purple, surrounded by a yellow halo (Agale *et al*. 2014). The increase in the number of lesions on leaves is favoured by specific environmental conditions, such as high relative humidity and optimal temperatures (Sonawane *et al.* 2020). Airborne spores of *A. porri* are responsible for the increased incidence of the disease in onion-growing areas (Suheri and Price 2001). According to the same source, the incidence of the disease increases as the plants mature until harvest. Infection of onion plants by *A. porri* results in reduced bulb development and delayed bulb ripening due to necrotic damage to leaf tissue, which inhibits bulb initiation due to insufficient food supply via photosynthesis (Black *et al*. 2012). Affected plants eventually show complete leaf desiccation. Yield losses can reach up to 97% (Yadav *et al*. 2014), and 100% of the seed crop in favourable weather conditions of the pathogens (Schwartz 2004).

To control the spread of purple onion spot, it is necessary to understand growers' perceptions and identify

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hotspots in disease-prone areas. Yet there is little information on growers' perceptions, incidence and severity of onion purple blotch in Burkina Faso, although this information is useful in designing effective control strategies against the disease. This observation justifies the present study. The aim of this study was to analyze producers' perceptions and to assess the incidence and severity of purple blotch in onion farms in Burkina Faso.

Materials and Methods

Study area

The study was carried out in 6 onion-producing provinces of Burkina Faso (Kadiogo, Oubritenga, Koudougou, Sanguié, Bazéga and Ganzourgou). All the studied provinces belong to the Sudanian agroecological zone, with the annual rainfall ranging from 700 to 900 mm. These provinces are among the main onion production areas in Burkina Faso.

Data collection

Questionnaire was administered in February and March 2021. Three localities were selected for the survey and in each locality, three farms were chosen to collect incidence and disease severity data. In total, 54 fields were surveyed. The selected plants in the selected fields were at least 60 days old. Producers from all fields visited were interviewed. The information on the onion variety used, the fertilizers used and the producers' perception of the causes of the disease were collected.

Assessing the incidence and severity of purple blotch

In a selected farm, three quadrats of one square meter each were laid out along one of the diagonals of the field (Hubert *et al.* 2016). Onion plants were counted in each quadrat as well as the plants showing symptoms of purple blotch. The incidence of purple blotch was assessed using the formula 1 The disease incidences were calculated according the onion varieties, the fertilizer and the province.

I (%) = (n/N) ×100 (Formula 1)

Where I (%): incidence of purple blotch, n: number of diseased plants in the quadrat, N: total number of plants in the quadrat.

Disease severity was scored using the Abo-Elyousr *et al.* (2014) scale (0 to 4) (Table 1). In each quadrat, ten onion plants were randomly selected to assess the severity of purple blotch. The severity rate was calculated following the formula used by Bost and Veitia (2014):

SI (%) = (**n**×**v**) / (**i**×**N**) × 100 (Formula 2)

Where: SI = severity index; n = the total number of plants per degree on the scale; v = the rating on the diagrammatic scale; i = the highest rating on the diagrammatic scale; N = total number of plants observed.

Table 1: Severity assessment scale

Severity rating	Percentage of leaf surface infected
0	No symptoms of the disease
1	1 à 25%
2	26 à 50%
3	51 à 75%
4	76 à 100%

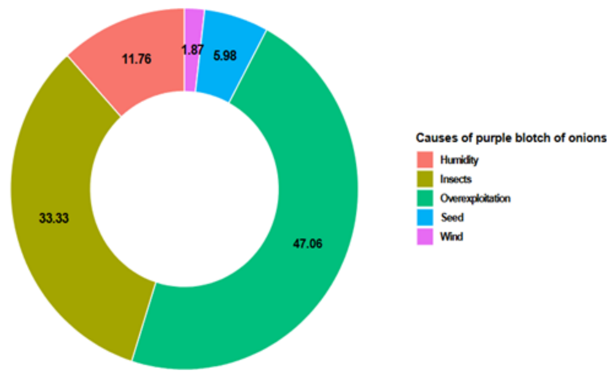

Fig. 1: Causes of purple blotch of onion (%) according to producers

Statistical analysis

R software version 4.1.1 was used for statistical analysis. Comparison tests were performed using the Student Newman-Keuls test at the 5% threshold. Disease incidence and severity were expressed as percentages.

Results

Causes of purple blotch on onion

Producer's perception of the causes of purple blotch of onion in different farms are shown in Fig. 1. A significant proportion (47%) of farmers reported that the overuse of the fields was the cause of the disease. Other (33%) mentioned that the disease infestation was related to the presence of insects in the farms. Some (12%) gave as reason the relatively high humidity in the farms which causes the disease on onions. Only 6% and 2% stated that the onion purple blotch is a seed-borne and wind-borne respectively.

Incidence and severity of purple blotch of onion per province

The incidence and severity of purple blotch of onion in each province are shown in Fig. 2. These results showed that the incidence rate and severity of the disease were relatively high in all provinces. The incidence rate ranged from 47% to 62%, while the severity ranged from 33 to 49%. Analysis of variance revealed no significant differences ($P \geq 0.447$) between provinces for these two parameters.

Incidence and severity of purple blotch of onion according to different varieties

Four varieties, namely Violet de Damani, Violet de Galmi, Safari and a local variety, were recorded in farmers' fields. The results showed that symptoms of purple blotch of onion were observed on all varieties cultivated. Among the four varieties, the incidence ranged from 52% to 65% and the severity from 37% to 49%. The variety Safari recorded the highest incidence with a rate of 65% (Fig. 3). It was followed by the Local and the Violet de Galmi varieties while the violet de Damani recoded the lowest values of incidence and severity. Analysis of variance revealed no significant differences ($P \geq 0.342$) between varieties for these two parameters.

Incidence and severity of purple blotch of onion in relation to the fertilizers used

Mineral and organo-mineral fertilizer were the two fertilizers used by the producers. The data showed that the incidence of the disease was very high (72%) in farms were only mineral fertilizer was applied compared to the farms where organo-mineral fertilizer (44%) was used (Fig. 4). The severity of disease was also very high (63%) in farms cultivated with mineral fertilizer compared to the farms where organo-mineral fertilizer (25%) was applied. Analysis of variance revealed significant differences ($P = 0.001$) between these two parameters depending on the type of fertilizer used.

Discussion

Surveys showed that producers attributed five causes to the disease: overuse of soil, insects, seed, humidity and wind. These are stress factors, which favour the infestation of purple blotch in onion. Overuse of the soil can lead to depletion of mineral elements, which may contribute to the development of the disease (Aye and Masih 2023). Relative humidity above 75% is conducive to the establishment of purple blotch of onion (Jhala *et al*. 2017). Wind speed increases the number of spores dispersed in fields (Mukherjee *et al*. 2021). Insect damages also increase the susceptibility of onion leaves to *A. porri* infection. Studies of Nainwal *et al.* (2020) showed that *Thrips tabaci* L. favoured the spread of the disease, particularly in areas with heavy thrips ifestation. The present study also looked at the incidence and severity of the disease in relation to onion-growing provinces, onion varieties and fertilisation. A possible reason for this is the presence of the pathogen *A. porri*, which is widespread in these provinces. An inventory of fungal spcies has shown that *A. porri* is the most abundant species (Dabiré 2017). Moreover, the lack of effective management strategies is leading to the spread of the disease.

Continued use of chemical fungicides could lead to the emergence of resistant strains (Takahashi *et al*. 2020). In addition, the biotic and abiotic factors mentioned above could contribute to the severity of the disease. The incidence rate and severity index of purple blotch assessed depend on the onion varieties grown. Studies by Mohammed *et al*. (2022) on the effect of purple blotch on the main onion varieties grown in Uganda showed that none of the onion varieties tested showed a resistant immune response to purple blotch disease. Similarly, a study carried out by Bal *et al*. (2019) on the screening of 23 onion genotypes against purple blotch disease found that no genotype was immune to the disease.

The incidence rate and disease severity index were very high in the farms where only mineral fertilizer was applied. This result suggests that organo-mineral fertilizer is

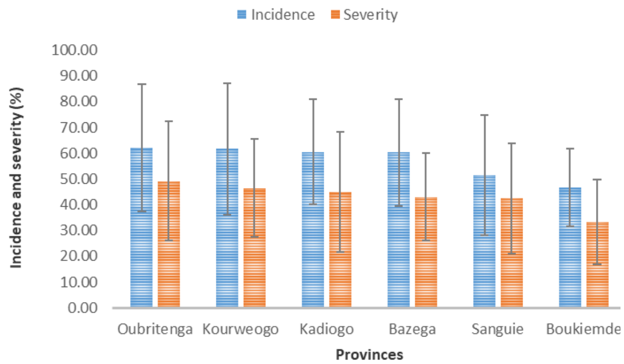

Fig. 2: Incidence and severity of purple blotch of onion by province

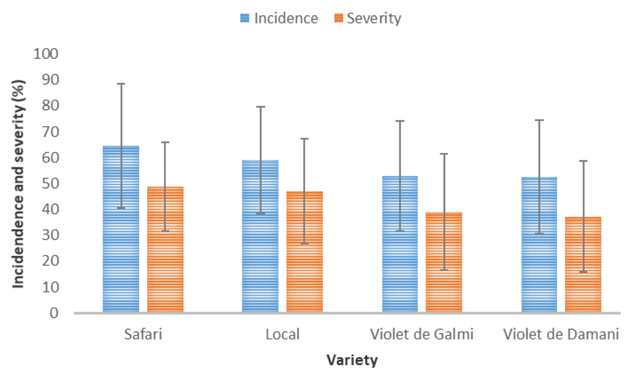

Fig. 3: Incidence and severity of purple blotch in different varieties of onion

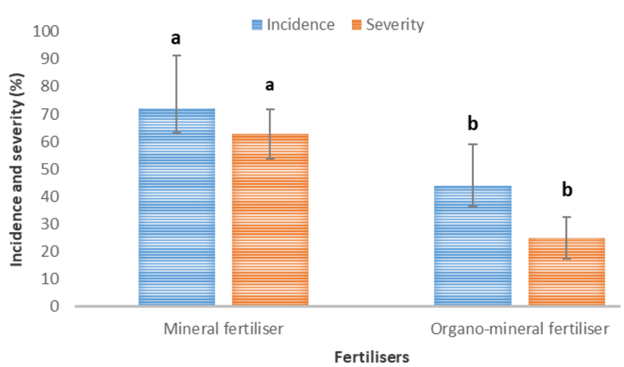

Fig. 4: Incidence and severity of purple blotch of onion as a function of fertilizer

Bars with the same letters are not significantly different effective in reducing the incidence and severity of purple blotch of onion. It has been observed that organic soil improvers have suppressive effects on biotic stressors, especially soil-borne diseases (Ahmed *et al*. 2020). They contain beneficial microorganisms that inhibit the growth and activity of pathogens, thereby controlling the disease. In addition, organic amendments can stimulate the development of the plant defence mechanisms, such as hypersensitivity reactions and systemic acquired resistance. These defence strategies help plants to cope with biotic stress and fight diseases effectively (Azim 2019). Organic amendments also improve soil fertility, which indirectly contributes to disease control Ramzan *et al*. (2021). In addition, sequestering atmospheric carbon in the soil through organic amendments could help to combat climate change, which may have an indirect effect on disease incidence and severity (Karki and Gc 2014).

Conclusion

Onion producers in Burkina Faso identified that overharvesting, insects, humidity, seeds and wind are the main causes of the purple blotch of onion. The incidence and severity of disease was relatively high in all the provinces. All the onion varieties cultivated by farmers showed symptoms of the disease. The study also showed that the incidence rate was higher in mineral fertilized farms compared to the organo-mineral fertilized farms. The results provide basic evidence for the development of management strategies to improve onion production in the country.

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Author Contribution

HA and KNP collected the data; HA, KHS and AO analysed the data and produced the illustrations; HA, KHS, DK, MS and AO drafted and corrected the manuscript; KK supervised all the work.

Conflict of Interest

All authors declare no conflict of interest.

Data Availability

All data generated or analyzed during this study is present in its full form in this manuscript.

Ethics Approval

This study did not involve any endangered or protected species. Thus, no specific ethical approval was required.

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