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Research Article

PREVALENCE OF TOMATO'S BACTERIAL AND FUNGI DISEASES IN INERA FARAKO-BA STATION IN BURKINA FASO

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ABSTRACT

In Burkina Faso, plant pathogens constitute constraints on tomato production. This study makes the diagnostic on the majority of diseases at the experimental station in Farako-Bâ. The incidence and severity were evaluated in a expérimental design to evaluate the agronomic performances of 208 tomato accessions. An inventory of fungal and bacterial species was made from symptomatic samples. Morphological characterization was carried out using isolates of the majority species. The following fungal diseases: early blight, Sigatoka blight, corynesporiosis, fusarium wilt and gray mold have been identified with respective incidences of 45%, 34%, 13%, 5% and 3%. Furthermore, bacterial diseases such as bacterial speck, bacterial scab, bacterial canker and bacterial wilt appear on the studied tomato plants with respective prevalences of 58%, 26%, 15% and 1%. The severity of all these diseases on the different accessions gradually evolves until reaching a high number of leaves, stems and fruits. The induced lesions were significantly different between the strains. Given the importance of the disease, molecular characterization of the species is necessary to envisage effective control.

Keywords: Diseases, Pathogens, Tomato, Burkina Faso**.**

INTRODUCTION

In Burkina Faso, tomatoes are grown throughout the national territory. Tomato cultivation therefore constitutes a lucrative activity for many producers in rural, urban and peri-urban areas, and therefore generates significant foreign exchange for the national economy. This importance is reflected in the fact that in urban and peri-urban areas, many vulnerable populations make a living from it production and marketing (MAHRH, 2011). Also, the tomato plays an important place in the human diet. It is consumed either raw, or cooked, or in by-products such as fruit juices, Ketchup and preserves. In recent decades, tomato consumption has been associated with the prevention of several diseases such as cancer or cardiovascular diseases (Wilcox *et al*., 2003). Despite the advantages it presents economically and nutritionally, the tomato sector unfortunately faces numerous biotic constraints including parasitic pressure which can reduce yields by 90% (CORAF, 2010). Indeed, fungi and bacteria constitute major biotic constraints for tomato production (Traoré *et al*., 2022). Faced with this situation, all local tomato accessions were screened to identify their agronomic performance and their susceptibility to diseases in order to improve them. Thus, 208 lines were evaluated in a real environment at the Farako-Bâ station.

MATERIAL AND METHODS

Experimental sites

The experimental site selected is that of the INERA Farako-Bâ research station located on the Bobo-Dioulasso-Banfora axis. Its geographical coordinates are -4°20' West longitude and 11°06' North latitude with an altitude of 405 m. The Farako-Bâ station covers an area of 475 ha (Kaboré, 2014). The soils of Farako-Bâ, like the soils of western

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Burkina-Faso, essentially contain tropical ferruginous soils that are poorly leached. The climate of the area is South Sudanese and characterized by the alternation of two seasons. A rainy season which lasts 5 to 6 months (May to October) with rainfall varying between 950 mm and 1200 mm; and a dry season from November to April. Most of the precipitation occurs from June to September over 50 to 70 rainy days (Guinko, 1984). During the test, the Farako-Bâ station received 923.4 mm of water spread over 57 days. The minimum average temperature of the site was 15.05°C to 21.9°C compared to 30.41°C to 35.93°C for the maximum (Figure 1).

Plant material

The plant material consists of 208 tomato accessions collected in Burkina Faso.

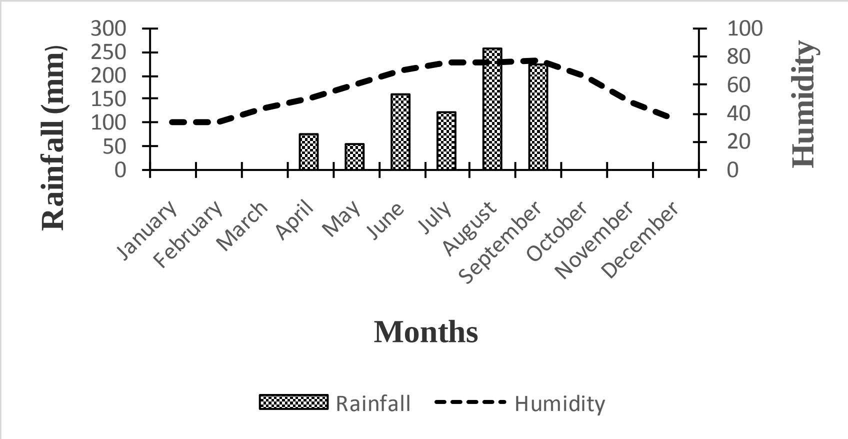


Figure 1. Climatic characteristics of the study area.

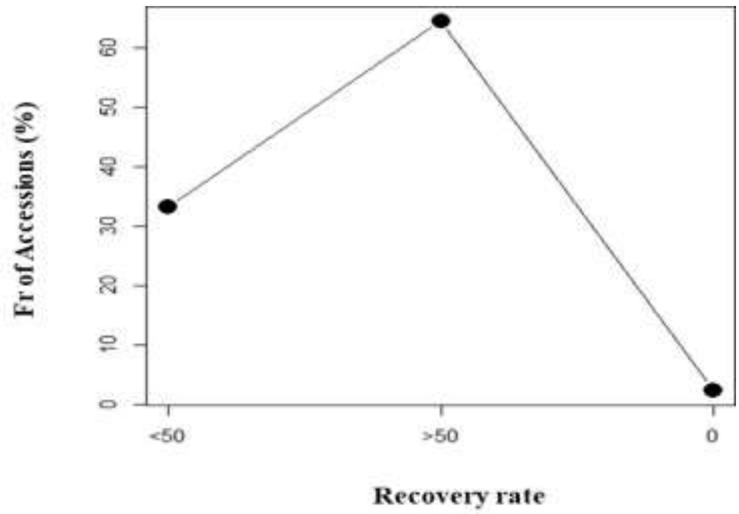


Figure 2. Recovery rate of tomato accessions after transplanting.

Expérimental disign

The experimental ddisign used is a tested collection. The collection tested is a disign that can hold more than 50 entries. It includes at least one known witness repeated systematically at regular intervals. This device consisted of 11 blocks. The length of each block is 25 m, and the width is 5 m. The land preparation work consisted of deep plowing followed by harrowing and manual leveling. The background manure used is compost at a dose of 20 t/ha. After this work, the experimental field and the elementary plots were delimited. The sowing lines were drawn using a row spreader. The tomato plants were transplanted 27 days after sowing. Regarding maintenance, three manual weedings were carried out. NPK 14-23-14-6S was applied as a fertilizer at a rate of 1.5 kg/100 m^2 on the 14th Days after transplanting (DAT) and the second at the start of flowering on the 45th DAT. The treatments were applied 10 DAT with chlorpyriphos-ethyl at a dose of 60 kg/ha or 3 kg Ma/ha.

Health assessment on tomatoes

Two (02) weeks after the implementation of the trial, the recovery rate was evaluated. The field evaluation of the different tomato diseases was carried out by direct observation of the different symptoms developing on the organs (leaves, stems and fruits) of the plants on the basis of the identification key (Brad and Wayne, 1997). Five observations were made on a total of 1242 plants. Observations were carried out every two (02) weeks. The severity of different diseases was assessed based on the type of symptom. For bacterial diseases whose symptoms are expressed by wilting of the vegetative system, the severity was evaluated on the basis of the Launey scale (2012), 0 (without symptoms) and 1 (plant ¾ withered or death from wilting). For fungal and bacterial diseases expressed by leaf spots, their severity was evaluated using a scale proposed by IMI (1983) which is described as follows:

0 : unblemished;

1 : 1-10% small spots on less than 50% of plant leaves;

2 : 10-30% spots on less than 50% of plant leaves;

3 : More than 30% spots on more than 50% of the leaves of the plant.

Sampling and isolation of plant pathogens

After the field diagnosis, a sample of diseased organs (stem, leaves, fruits) was taken for the identification of the disease. All of the organs removed were sent to the laboratory for diagnosis. The collected organs were first washed with tap water and cut into small fragments of approximately 2 cm. Under the laminar flow hood, these stem fragments were disinfected in a 70% alcohol solution, then in 1% bleach and rinsed with sterile distilled water. Regarding bacterial symptoms, the fragments are crushed and diluted in Bioreba sachets. After 30 min, 50 µL of the suspensions were cultured on SMSA medium in Petri dishes. The Petri dishes were incubated in an inverted position in the oven at 28°C for 48 hours. The purification of the isolated strains was carried out on SMSA medium. The pure strains were preserved in a sterile medium composed of NB and 50% glycerol in the respective proportions of 2/3 and 1/3 inside 1.5 µL cryovials at -20°C.

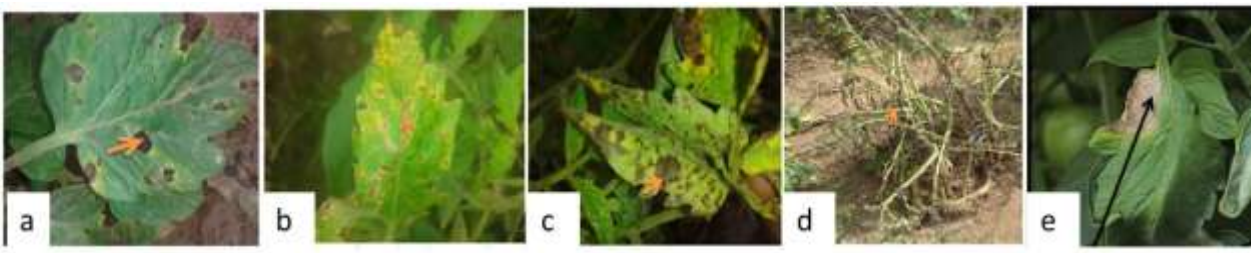
For fungal symptoms, the cut and disinfected tomato samples were placed on damp blotting papers contained in Petri dishes. The Petri dishes were incubated under 12 hours of near Ultra Violet light alternating with 12 hours of darkness at 22°C for four (04) to five (05) days. At the end of the incubation, the developed colonies were observed under a magnifying glass and then microscopic preparations were made from each colony and observed under an optical microscope. The conidia observed under the microscope are compared to the images and descriptions of Mathur and Kongsdal (2003). The mycelium is then purified and stored in the refrigerator.

Data analyzed

The Excel 2010 spreadsheet was used to enter the collected data and create the various graphs. The position and dispersion characteristics of the elementary statistics were calculated using SAS software version 9.3. R software was used to create the recovery rate graph.

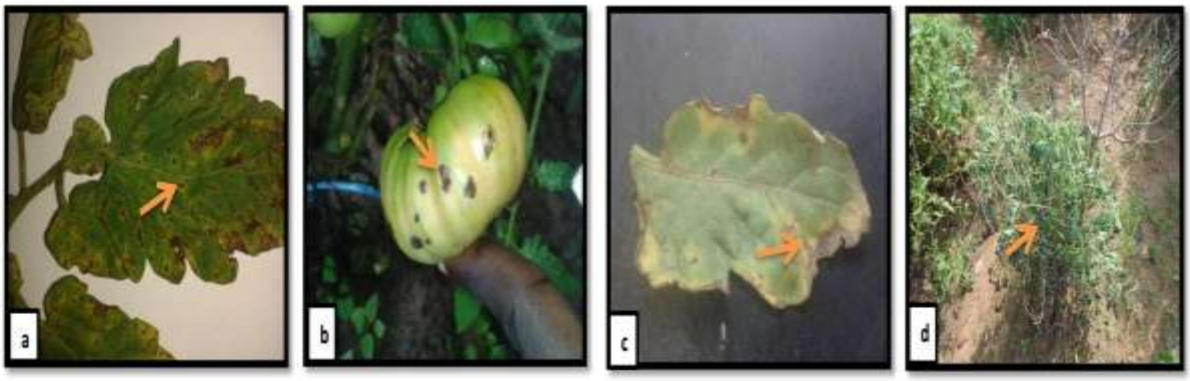
RESULTS AND DISCUSSION

The evaluation of the recovery rate of the different accessions reveals that, of the 208 accessions studied, 64.42% of the accessions have a recovery rate greater than or equal to 50%, 33.17% of the accessions have a low recovery rate, less than 50%, and 2.40% of accessions did not experience a recovery (Figure 2). The results of the surveys carried out indicate the presence of five (05) phytopathogenic fungi on tomato plants responsible for serious fungal diseases. The different symptoms diagnosed are concentric spots of irregular shape on the leaves, stems and fruits (Figure 3). These diseases are alternaria caused by *Alternaria solani* which manifests itself by concentric, irregular spots of dark brown color to black on the leaves. Corynesporiosis which manifests itself as small, necrotic, concentric spots surrounded by a yellow halo. It is caused by *Corynespora cassiicola*. Cercospora blight which manifests itself as sooty yellow spots on the leaves. The causative agent is *Cercospora fuligena*. Fusarium wilt, caused by *Fusarium oxysporum* and manifests itself by total drying out of the plant. Gray mold which causes lesions at the periphery and at the end of the leaf blade. These are brown and moist and subsequently become necrotic. This disease is caused by *Botrytis cinerea*. The results of the observations, based on the tomato disease identification key of Brad and Wayne (1997), revealed characteristic symptoms of bacterial speck, bacterial canker, bacterial scab and bacterial wilt on tomato plants (Figure 4).



(a) Symptoms of alternaria on leaves **(b)** Corynesporiosis lesion on leaf **(c)** Symptoms of Sigatoka leaf blight **(d)** Fusarium wilt on tomato stem **(e)** Symptoms of gray mold

Figure 3. Symptoms of fungal diseases on tomato organs.



(a) Symptoms of bacterial leaf speck (b) Bacterial scab lesion on fruit (c) Tomato leaf affected by bacterial canker (d) Bacterial wilt on a tomato plant

Figure 4. Symptoms of bacterial diseases on tomato organs.

The Figure 5 represents the prevalence of fungal diseases and their evolution based on observations. These diseases have different periods and levels of appearance depending on time. Indeed, alternaria and corynesporiosis are the earliest diseases with an average prevalence of 45% and 13% respectively. However, Sigatoka remains late with an average prevalence of 34%. Fusarium wilt and gray mold were poorly represented with a respective prevalence of 5% and 3%. Regarding the severity, the statistical analysis of the severity of fungal diseases generally reveals that the diseases develop moderately on the accessions. Thus, the first two observations, July 23 (observation 1) and August 6, 2016 (observation 2), are marked by low disease severity with less than 10% of plant organs attacked. The third observation is marked by a high severity of 2.30 for early blight on the accessions. Besides early blight, the third observation is marked by average disease severity. The latest observations are distinguished by a high severity of alternaria, Sigatoka and corynesporiosis. In fact, these diseases infest more than 30% of the organs of the tomato plant. Unlike other fungal diseases, fusarium wilt was found to be the most severe at last observation. Indeed, plants affected by fusarium wilt present a high state of wilting and drying out (Figure 6).

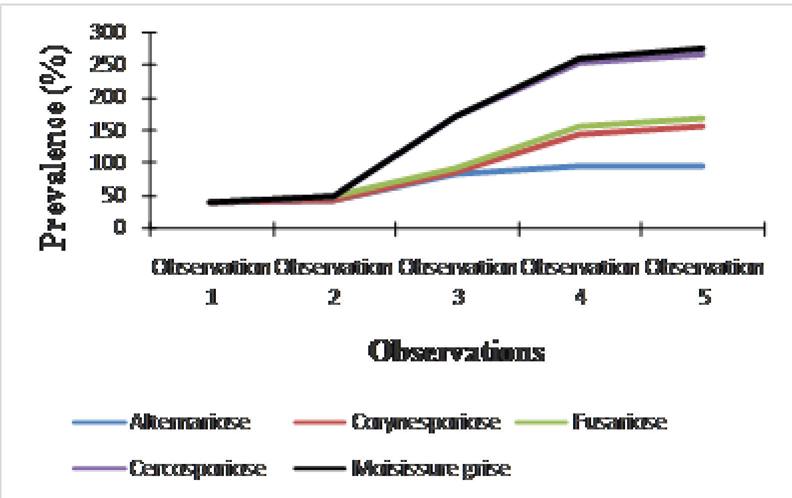


Figure 5.Prevalence of fungal diseases on tomato accessions.

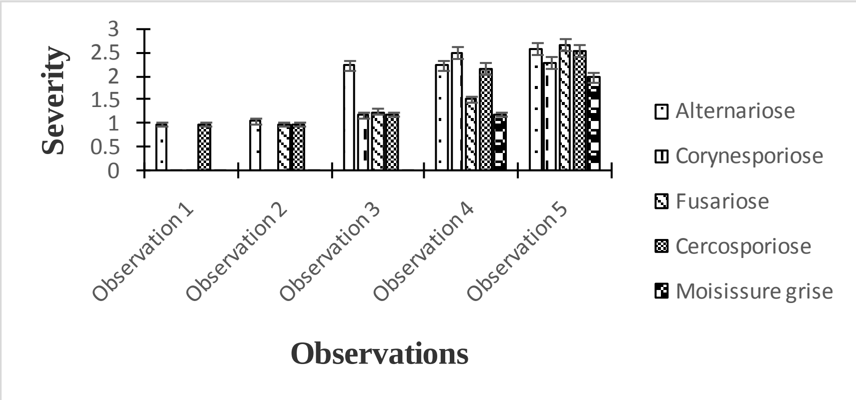


Figure 6 : Average severity of fungal diseases during observations.

The figure 7 represents the evolution of the prevalence of bacterial diseases based on observations. Indeed, we observe different periods and levels of appearances depending on time. Thus, bacterial speck and bacterial scab with a respective prevalence of 58% and 26% are the earliest diseases, while bacterial canker is the least early with a prevalence of 15%. Bacterial wilt appears late with an average prevalence of only 1%. Regarding to the severity, statistical analysis indicates that less than 10% of tomato plant organs were attacked by phytopathogenic bacteria during the first two observations (Figure 8). Bacterial speck and bacterial scab are the most severe at the level of the last observation with respective severities of 2.34 and 2.3.

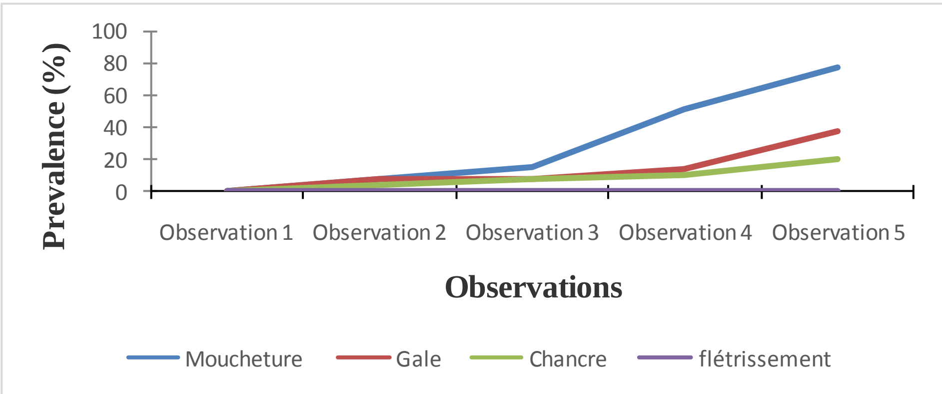


Figure 7. Prevalence of bacterial diseases on tomato accessions.

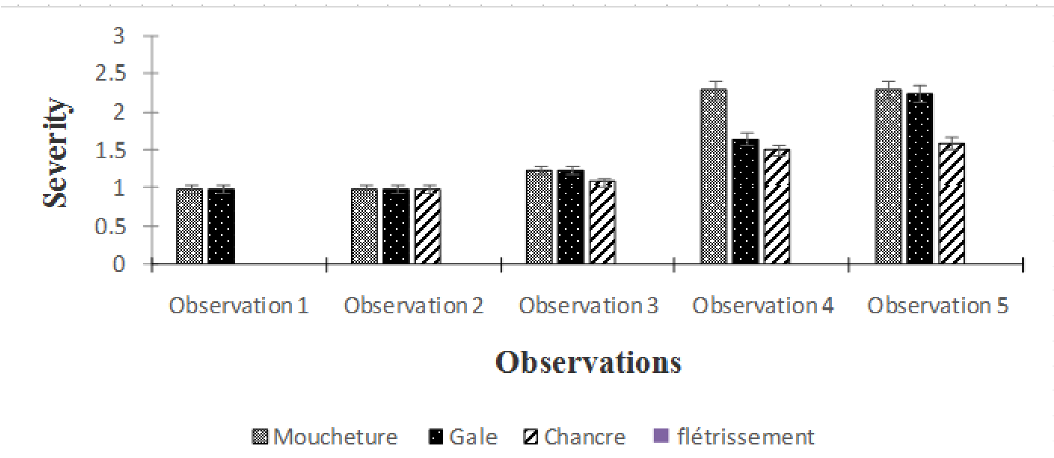


Figure 8. Average severity of bacterial diseases during observations.

The recovery rate of the 208 accessions varies considerably from one accession to another. This variation within the accessions could be explained by the level of adaptation of the plants to the environment and also by a variation in climatic factors (temperatures and relative humidity). For a good recovery of the tomato plant, a soil temperature between 25°C and 35°C is recommended. But below 15°C, it reduces water consumption and above 35°C causes slower vegetation. During the present study minimum temperatures from 21.60°C to 21.90°C; and maximum of 30.42°C to 31.17°C were recorded. The relative humidity oscillated between 74.42% and 78.31%. These provisions would partly explain the results obtained on the resumption of accessions.

The level of infestation of tomato plants by pathogens increases during the observations. Diseases gradually appear on tomato accessions from July to August before invading almost all accessions in September. The progression in the level of infestation of accessions could be explained by the environmental conditions favorable to pathogenic agents. According to Messiaen (1974), the particular conditions of temperature, humidity, solar radiation, the absence of essential mineral elements in the soil, the presence of toxic substances or a combination of these various formulations favor the proliferation of pathogenic agents. Mushroom spores are dispersed through the air as soon as conditions are favorable, that is to say when temperatures are between 10 and 32°C (optimum 27°C), andpreferably when the atmosphere is humid (more than 50% relative humidity) (Gerbeaud, 2017). Early blight is the most prevalent fungal disease in the open field. This result is in agreement with the work of Kabré (2016) who evaluated early blight in all the elementary plots of his experiment at the Farako-Bâ station. Also, the most dominant fungal diseases are alternaria and fusarium wilt (Son *et al*., 2016).

The preponderance of early blight is due to the pathogenic power of *Alternaria solani*, the pathogenic agent of the disease, and its ability to persist for a long time in the soil and in organ residues. In addition to alternaria, Sigatoka, Corynesporiosis, Fusarium wilt and gray mold appear on the accessions inspected with varying levels of appearance and severity from one accession to another. The difference in the appearance of these diseases and their severity on the plants observed could be explained by several hypotheses: the level of colonization of the soil by the respective pathogens, the origin of the plant material used, the reaction of the different accessions to the pathogens. . Indeed, each accession could show differences in behavior with respect to each of the identified pathogens. It could be sensitive, resistant, or tolerant. These differences would necessarily impact the level of occurrence of diseases. Indeed, the majority of market garden seeds used in Burkina Faso are likely to harbor phytopathogenic agents (Ouédraogo and Mortensen, 2003). According to Blancard*et al*. (2009), the dissemination of these agents over long distances occurs mainly through contaminated seeds and plants. In this context of inter- and intra-zone exchange of material, we are witnessing increasingly significant damage (Lopez *et al*., 2006). In addition, the history of the plot reveals that it had been fallow for several years before its use for the experiment. The prevalence of fungal diseases could also be explained by the existence of weed hosts in the fallow. Which species could harbor and transmit these diseases to cultivated accessions.Surveys of bacterial diseases in the field indicate that the various diseases, apart from bacterial wilt, appear early. The geographical origin of the seeds could be the possible source of dissemination of the pathogenic bacteria observed. The early appearance of these diseases would result from the sensitivity of the accessions. Also, one of the factors of vulnerability of accessions to these diseases would be the climatic conditions of the environment. According to Blancard *et al*., (2009), bacterial diseases are favored by humid climatic periods. Indeed, bacteria are very polyphagous and operate in conditions of high humidity and temperature varying from 5°C to 37°C, with an optimum of 22°C. They are preserved in the soil and plant debris of diseased plants.Bacterial wilt has a low pathogenic power on the accessions studied. Indeed, it appeared on only one accession (MlT5-2) out of the 208. This result is in agreement with the work.

CONCLUSION

The overall objective of the study carried out on the 208 tomato accessions was to contribute to the identification of fungal and bacterial diseases. The results highlighted a significant diversity of diseases on the tomato accessions and varieties studied. Indeed, five (05) fungal diseases (early blight, Sigatoka blight, corynesporiosis, Fusarium wilt and gray mold) and four (04) bacterial diseases (bacterial speck, bacterial scab, bacterial canker and bacterial wilt) were identified. The most severe fungal diseases are, in order of importance, alternaria, Sigatoka, and Corynesporiosis. And for bacterial diseases, they are bacterial speck and bacterial scab. Laboratory work on the identification of fungal pathogens indicates that Alternaria solani, Cercospora fuligena, Corynespora cassiicola, Fusarium oxysporum and Botrytis cinerea confirmed our diagnoses. As for bacterial agents, only the bacteria *Ralstonia solanacearum* was detected on MlT5-2 in the laboratory. At the end of our study, the following perspectives emerge in order to deepen the investigations on the subject, Deepen the study, by carrying out molecular characterizations of the pathogens in order to determine the appropriate means of control for each pathogen.

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