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Resistance of Local Eggplant Accessions to Bacterial Wilt Caused by *Ralstonia solenacerum* in Burkina Faso

Traoré Oumarou[1, *], Kaboré Boukaré[2], Ouédraogo Abdou Rasmane[1], Zoré Awa[1], Boro Fousseni[2], Wonni Issa[2], Somda Irénée[3]

[1]National Center for Scientific and Technological Research (NCSTR), Institute for Research in Applied Sciences and Technologies (IRAST), Laboratory of Natural Substances and Technologies of Natural Products and the Environment (LNSTNPE), Ouagadougou, Burkina Faso

[2]National Center for Scientific and Technological Research (CNRST), Institute of the Environment and Agricultural Research (IEAR), Central Horticulture Laboratory (CHL), Bobo-Dioulasso, Burkina Faso

[3]Laboratory of Natural Systems, Agrosystems and Environmental Engineering (SyNAIE), Institute of Rural Development, Nazi Boni University, Bobo-Dioulasso, Burkina Faso

Email address:

oumaroutraor@yahoo.fr (Traoré Oumarou)

[*]Corresponding author

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Abstract: Bacterial wilt caused by *Ralstonia solanacearum* E. F. Smith is one of the phytobacterioses associated with nightshade. It is a market garden crop which is taken into account in the market garden crop development program by INERA breeders. It is appropriate to evaluate the behavior of agronomically important accessions with respect to bacterial wilt in Burkina Faso to guide the producers'choice. Indeed, five (05) accessions of *Gboma* (*Solanum macrocarpon* L.) from the INERA Farako-Bâ vegetable seed collection were evaluated under semi-controlled conditions on the experimental site of the INERA Farako-Bâ bacteriology laboratory. The vegetative development of plants, the susceptibility of accessions to disease, and the number of fruits were evaluated in a completely randomized design with ten (10) repetitions by accession. At the end of this study, the best agronomic performances were recorded with GBLS13; GBRT6; GBBD4. The average disease index rate obtained in each pot is higher than the potential threshold for the disease manifestation (more than 80%). The lowest rates were recorded with the GBL19 and GBBD4 accessions. All accessions tested were found to be susceptible to bacterial wilt. The recorded accessions have a low incidence rate (GBBL19 and GBBD4 from Sissili) gave more fruits compared to the others. Due to the importance of cultivation, it is appropriate to test a wide range of *Gboma* accessions availability in Burkina Faso.

Keywords: Resistance, Accesssions, Bacterial Wilt, *Ralstonia Solanacearum*, Burkina Faso

1. Introduction

Agriculture is the main income-generating activity in Burkina Faso. It is an agriculture essentially based on cereal crops. However, vegetable crops have increasingly occupied an important place in recent years and constitute one of the main sources of monetary income for households in rural areas [1]. Nowadays, African-type vegetables, which for a long time were considered secondary, are gradually being taken into account at national and international levels because of their nutritional values in the diet of rural areas and the real risk of genetic erosion. which threaten them [2]. Among these vegetables we can cite the African eggplants which occupy the third (3rd) place after the tomato and the onion [3]. It is one of the most commonly grown and consumed leaves and fruits vegetables in tropical Africa [4, 5]. It brings together several species such as *Solanum aethiopicum*, *Solanum macrocarpon* and others. Indeed, African eggplants provide large amounts of nutrients, such as carotenes and ascorbic acid which give an important role in nutrient metabolism and slowing degenerative diseases [6, 7]. Despite all these advantages, *Gboma* is subject to bacterial wilt caused by *Ralstonia solanacearum* like other *Solanaceae* [8, 9]. Indeed, diverse strains with aggressiveness levels of more than 80% have been identified in market garden in Burkina Faso [10]. This disease causes more than 100% loss of *Solanaceae* crops in the open fields [11]. In view of the recent studies of the genetic diversity of *Gboma* existing in Burkina Faso and its valorization [5]. It is therefore appropriate to test the sensitivity of local accessions to bacterial wilt to anticipate and to guide the producers and breeders' choice.

2. Material and Methods

2.1. Experimental Site

The trial was conducted in a semi-controlled environment in Bobo-Dioulasso on the experimental site of INERA-Farako-Bâ bacteriology laboratory. The geographical coordinates of the site are 11°15'61.1" from North Latitude and -004°28'60.0" from West Longitude. The climate of the study area is tropical with a rainy season from April to October and a dry season from November to March.

2.2. Material

The vegetable material consists in five (05) accessions of *Gboma* from Sissili and Sanguié (Table 1). This material was provided by the team of market garden seed breeders at INERA Farako-Bâ. Their choice is explained by the preliminary results of their observed agronomic performance [12].

Table 1. *Screened accessions.*

Accessions	Provinces	Sites of collect	Climatic zones
GBRT7	Sanguié	Réo	Soudano-sahelien
GBLS13	Sissili	Léo	Soudanien
GBRT6	Sanguié	Réo	Soudano-sahelien
GBLB19	Sissili	Léo	Soudanien
GBBD4	Sissili	Biéha	Soudanien

Source: [12].

2.3. Used Strains

One virulent (85%) bacterial strains of phylotype I (RUN5612 /DFGS542-I-31) was used to evaluate the resistance or tolerance of all the accessions [10]. In addition, laboratory equipment for bacterial cultures, test maintenance products, were also used: K optimal (Lambda-Cyhalothrine 15g/L + Acetampride20g/L;EC) for foliar treatments against insect pests and mites, NPK (15-15-15) and urea (46% N) as fertilizer.

2.4. Methodology

The experimental design is a completely randomized block of five (05) treatments (5 accessions) repeated 10 times each. The plants were transplanted 21 days after germination in the nursery into five (05) liters the pots previously containing potting soil sterilized at 100°C enriched with compost (30t. ha^{-1}). The pots were placed on an area of 21 m^2. NPK (15-15-15) at 300 $Kg.ha^{-1}$ and Urea (46% N) at 100 $Kg.ha^{-1}$ were applied to the plants respectively on the 15th and 30th day after transplanting. The pesticide at a dose of $1L.ha^{-1}$ was applied every 10 days. The plants were watered regularly. The scarified roots of three-week-old plants were inoculated with 10 mL of bacterial suspension calibrated at 10^8CFU. mL^{-1} [13].

Data is collected every three (03) days after the first appearance of symptoms (Figure 1) and on one month. During the observations, the bacterial wilt index was noted on the plants according to the scale (Table 2) [14]. The height and diameter of the collar were measured using respectively a graduated ruler and a digital caliper. The average dates of flowering and fruit set are obtained by observation for each accession after sowing. The average number of fruits was evaluated by weekly counting per plant and by treatments.

A: Healthy plant; B: Sick plant

Figure 1. *Symptoms of Bacterial Wilt on Gboma.*

Table 2. *Bacterial wilt symptom rating scale.*

Number	Sensitivity	Symptoms
0	Resistants	No symptom
1	Moderately	A sick leaf
2	Moderately	two diseased leaves
3	sensitive	Four or more diseased leaves
4	sensitive	Dead plant

The evaluation of the wilting index (FI) takes into account the notes 3 and 4. Thus, IF is expressed according to the formula of [15].

$$IF = \frac{N3+N4}{NT} * 100$$

IF is the bacterial wilt index at day after transplant (DAT); tk is the number of JARs during the observation. The wilting index data at different dates made it possible to evaluate the severity of the disease on these same dates and its evolution over time (AUDPC=f(t)).

$$AUDPC(t) = \sum_{i=1}^{n} [(IFB_i + IFB_{i-1})/2](t_i - t_{i-1})$$

AUDPC (t) is an area under disease progression days after transplanting; IFBi corresponds to IFB on the previous day of observation; IFB i + 1 corresponds to IFB on the day of observation; ti - 1 is the date of the rating; ti is the date of the previous observation.

2.5. Statistical Analysis

The collected data were entered into the Microsoft EXCEL 2016 spreadsheet. This spreadsheet was used to construct the graphs. The data were analyzed with RStudio 3.5.3 software). Analysis of variance was carried out using the Rcmdr package following Duncan's multiple comparison test.

3. Results and Discussion

3.1. Height and Diameter of the Collar of Accessions

Analysis of the data reveals a significant difference between the average heights of the different accessions tested (P=0.02 and R2=0.2). The average heights of the five (05) accessions are between 10 cm and 32 cm (Figure 2A). Accessions M2 (GBRT7), M3 (GBRT6) and M4 (GBBL19) have statistically similar median heights and are large compared to M1 (GBL13) and M5 (GBBD4). Regarding the diameter of the plant collar (figure 2B), we notice that there is no remarkable difference between the different accessions. All accessions have an average stem thickness of between 6 and 8 mm. The greatest thickness (7.6mm) of the collar was recorded with GBLS13 (M1) from Sissili and GBRT6 (M3) from Sanguié; then the smallest thickness (6;89) was recorded with GBBD4 (M5) from Sissili.

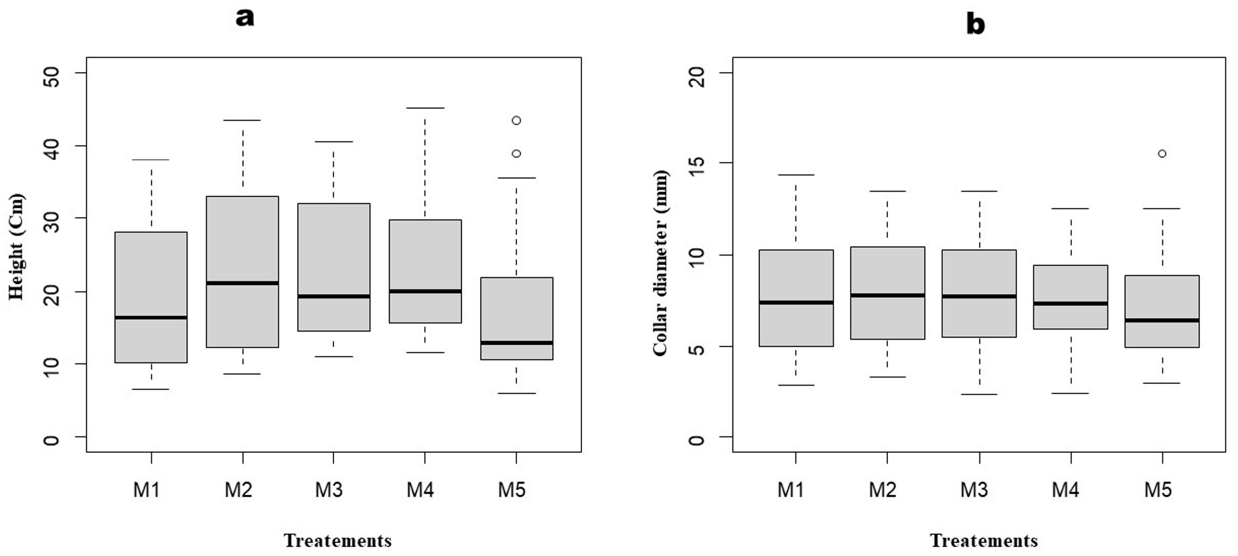

Figure 2. *Average heights and diameter of the different tested accessions.*

3.2. Date of Flowering, Fruit Set and Number of Fruits

The table 3 presents the analysis results on the average dates of flowering and fruit set on the one hand and on the other hand the number of fruits obtained by accessions. Indeed, there is a significant difference between the average flowering and fruit setting dates of the accessions. All accessions have flowering dates between 70 and 80 Days after sowing (DAS). The latest date (80 DAS) was observed with GBBD4 (M5). However, the GBRT6 (M3) and GBBL19 (M4) accessions were the earliest with 70 Days after sowing (DAS). As for the average fruit setting dates, observation of the table shows a difference between the five (05) accessions. Fruit set evolves with flowering dates. Thus, the fruits appear early (around 78 days) on GBBL19 (M4) and late (around 93 days) on GBBD4 (M5). Considering the number of fruits evaluated, we notice that there is no statistical difference between the accessions. However, the greatest number of fruits (4) was recorded on the early and late accessions.

Table 3. *Average dates of flowering, fruit set and average number of fruits per accession.*

Accessions	Average flowering dates	Average fruit setting dates	Average number of fruits
M1 (GBL13)	74.8^{ab}	85.3^{b}	2^{a}
M2 (GBRT7)	73.5^{b}	83.7^{bc}	3^{a}
M3 (GBRT6)	70.1^{b}	81.5^{bc}	3^{a}
M4 (GBLB19)	70.1^{b}	78.3^{c}	4^{a}
M5 (GBBD4)	79.7^{a}	92.6^{a}	4^{a}

3.3. Disease Incidence

The figure 3 below shows the disease index rate recorded on the different accessions. The highest rate was observed with GBRT7 (M2) with a percentage of 94.4% and the lowest disease index rate with GBBL19 and GBBD4 (82.22%). The incidences recorded by accession are well above the threshold of harm to cultivation.

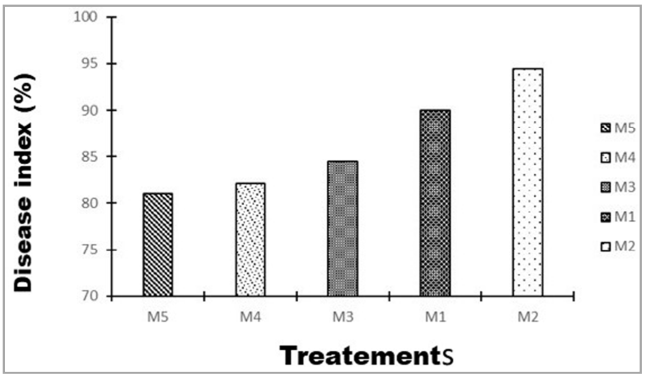

Figure 3. *Bacterial wilt index by treatement.*

3.4. Disease Progression

The figure 4 shows a rapid evolution of the disease from the first period of observations with all accessions. The majority of accessions reached 100% disease manifestation from the fourth observation period (20 days after inoculation). There are three disease severity groups out of the five (05) accessions. Indeed, the GBL13 (M1) and GBRT7 (M2) accessions reached 100% between the first period of observations (6 days after inoculation). The GBRT6 (M3) and GBBD4 (M5) accessions reached 100% manifestation of the disease from the third observation period (15 days after inoculation). The disease progression is relatively low on the GBBL19 (M4) accession compared to the others. In fact, the disease appeared on all the plants in the fourth period of observations (20 days after inoculation).

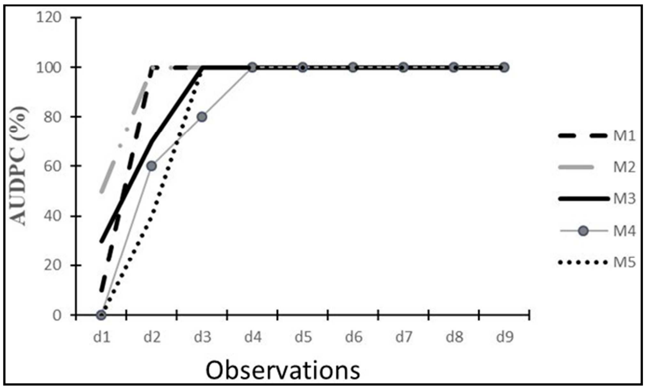

Figure 4. *Disease progression by accession.*

4. Discussion

The best vegetative growth parameters measured (heights, crown diameter) were recorded on the GBLS13, GBRT6 and GBBD4 accessions. Accessions do not have the same capacity for root systems to absorb nutrients and water. This explains the difference observed in vegetative development and growth for each accession. Our results agree with those of [12]. Indeed, out of all the 32 evaluated accessions, GBLS13 and GBBD4 are among the 5 accessions which presented significant vegetative growth. The accessions having received the same quantity of nutrient element, the difference observed in thickness could be explained by the fact that the cambium possessed by each accession does not produce the same quantity of new cells intended for growth in diameter plant. The variability observed in the average flowering dates of each accession could be explained by the difference in their genetic characteristics. Indeed, the study by [12] showed four (04) groups based on their agromorphological performance. These results are consistent with previous studies by [2] which showed great genetic variability in the african's eggsplants. As for the total number of fruits, a difference is observed between the accessions. The analysis shows us that accessions with a long cycle (average date of flowering and late fruit set) gave more fruits compared to accessions with an early cycle. The significant differences between the minimum and maximum values reflect a great variability of accessions. These results are in agreement with those of [2, 16, 17] which demonstrated the existence of great variability in African eggplant accessions. The analysis of the results shows that the disease was less severe in the first moments of observation on the GBLB19 accessions. Indeed, the accessions received the same dose of inoculum and subjected to the same climatic conditions. Thus, the difference in behavior is due to the genetic characteristics that each accession possesses. Each accession has its own genes which give it a certain resistance to the pathogen. The high sensitivity of the five (05) accessions to bacterial wilt would be linked to the genetic characteristics of the species. Indeed, similar studies have shown a sensitivity of more than 80% of the species *Solanum macrocarpon* compared to the species *Solanum aethiopicum* which recorded less than 20% with respect to bacterial wilt in Ivory Coast [4]. Also, *Solanum macrocarpon* plants used as rootstock in Congo showed susceptibility to bacterial wilt greater than 50% [18].

5. Conclusion

The present study is part of the dynamic of finding *Gboma* accessions resistant or tolerant to *Ralstonia solanacearum* and presenting interesting agronomic characteristics. At the end of this study, the best agronomic performances were recorded with GBLS13; GBRT6; GBBD4. The average disease index rate obtained in each pot is higher than the potential threshold for disease manifestation. The lowest rates were recorded at GBL19 and GBBD4 (82.22%). In short, we notice that the accessions used are all sensitive to bacterial wilt. Also, the accessions with a low incidence rate gave more fruits unlike those with the highest incidence rate. Seeing the high sensitivity of the five (05) accessions to the disease, it is appropriate to do direct studies on the selection of resistant varieties, to test other *Gboma* accessions from other agroclimatic zones and to train producers and agricultural agents on good agricultural practices to further reduce pressure in the production areas of *Gboma*.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] A. Z. Sani, “Contribution des cultures maraichères dans le renforcement de la résilience sociale: Cas de commune de Malbaza dans la Région de Tahoua, mémoire de licence ès sciences agronomiques”, Université de Tahoua, 43p, 2019.

[2] D. Nyadanu, & S. T. Lowor, “Promoting competitiveness of neglected and underutilized crop species: comparative analysis of nutritional composition of indigenous and exotic leafy and fruit vegetables in Ghana”, *Genet Resour Crop Evol*, (62): 131-140, 2014.

[3] R. N. Lester, & A. Seck, “*Solanum aethiopicum L*. In: *Grubben GJH, Denton OA* (Editeurs). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Pays Bas”, 2004.

[4] L. Fondio, L. N. N’Tamon, F. N. Hala *et al*. “Evaluation agronomique de six cultivars d’aubergine africaine (*Solanum* spp.) de la nouvelle collection des plantes légumières du CNRA”, *Agronomie Africaine* 20 (1): 69–79, 2008.

[5] B. Kaboré, B. Sawadogo, M. Kiébré, *et al*. “Genetic Diversity of a Collection of *Solanum macrocarpon* from Burkina Faso Revealed by Microsatellite Markers”, *International Journal of Genetics and Genomics*, Vol. 7, No. 2, pp. 27-33. 2019. doi: 10.11648/j.ijgg.20190702.12.

[6] C. Yi-Fang, S. Jie, W. U Xian-Hong, *et al*.)." Antioxidant and anti-proliferative activities of common vegetables Review". *Journal of Agricultural and Food Chemistry* 50, pp 6910-6916, 2004.

[7] N. C. Shalom, C. O. Abayomi, K. E. Okwuchukwu *et al*. "Proximate and Phytochemical Analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon*, L. Fruits", Research Journal of Chemical Sciences, Vol. 1(3): 63-71, 2011.

[8] R. Sikirou, B. Zocli, L. M. Paret *et al*. "Le flétrissement bactérien de ‘Gboma’ (Solanum macrocarpon) au Bénin est causé par *Ralstonia solanacearum*", Poster, Institut National des Recherches Agricoles du Bénin 1p, 2015.

[9] O. Traoré, "Diversité génétique et pathogénique de *Ralstonia solanacearum* E. F. Smith, agent responsable du flétrissement bactérien de la tomate et évaluation des méthodes de lutte contre la maladie au Burkina Faso", thèse de doctorat unique, Université Nazi BONI, Bobo-Dioulasso, Burkina Faso, 144 p, 2019.

[10] O. Traoré, I. Wonni, G. Cellier *et al*. "Genetic and pathogenic diversity of *Ralstonia solanacearum* species complex strains isolated in Burkina Faso", *Journal of Phytopathology*, 00: 1-11, 2022.

[11] D. Blancard, H. Loterrot, G. Marchoux *et al*. "Les maladies de la tomate identifier, connaître, maitriser", Édition *Quae* 679p, 2009.

[12] B. Kaboré, R. E. Traoré, Z. Kiébré *et al*. "Phenotypic diversity of accessions of Gurunsi eggplant (*Solanum macrocarpon* L.) from Burkina Faso", *Global Journal of Crop, Soil Science and Plant Breeding*, Vol. 6 (1), pp. 296-305, 2018. doi: http://www.globalscienceresearchjournals.org/.

[13] N. N. Winstead & A. Kelman, "Inoculation techniques for evaluating resistance to *Pseudomonas solanacearum*", *Phytopathologie* 42(11): 628-634, 1952.

[14] B. Coupat-Goutaland, D. Bernillon, A. Guidot *et al*. "*Ralstonia solanacearum* virulence increased following large inter strain gene transfers by natural transformation", *Molecular Plant Microbe Interactions* 24: 497-505, 2011.

[15] M. J. Jeger & S. Viljanen-Robinson, "The use of area under the disease progress curve (AUDPC) to assess quantitative disease resistance", *in cropcultivars Theoretical and Applied Genetics* 102: 32-40, 2001.

[16] K. P. Bationo, B. Sawadogo, K. R. Nanéma *et al*. "Characterization of *Solanum aethiopicum* (*Kumba group*) in Burkina Faso", *International Journal of Science and Nature*, 6 (2), 169-176, 2015.

[17] B. Sawadogo, K. P. Bationo, N. Sawadogo et al. "Variations, correlations and heritability of the interest characters for selection of African eggplant (*Solanum aethiopicum* var *Kumba*) from Burkina Faso", *African Crop Science Journal*, Vol. 24, No. 2, pp. 213, 2016.

[18] C. I. Nguinda-Akany, I. B. Ollandet, G. R. A. Kombo *et al*. "Effet porte-greffes de cultivars d’aubergines africaines sur l’incidence du flétrissement bactérien en culture de tomate durant la saison des pluies à Brazzaville", *Journal of Applied Biosciences*, 150: 15448–15456, 2020.