Research & Development
2022; 3(1): 11-17
http://www.sciencepublishinggroup.com/j/rd
doi: 10.11648/j.rd.20220301.13

Perceptions of Tomato (*Lycopersicon esculentum Mills*) Producers, on Bacterial Wilt and Other Cultivation Constraints, in Major Production Areas in Mali

Abdoulaye Youssouf Camara[1, *], Aminata Dolo[1], Sory Sissoko[2], Mamadou Oumar Diawara[2], Seriba Ousmane Katile[3], Wubetu Bihon Legesse[4], Kadiatou Toure[1], Amadou Hamadoun Babana[2]

[1]Fruit and Vegetable Programme, Institute of Rural Economy (IER), Bamako, Mali

[2]Department of Education and Research of Biology, University of Sciences, Techniques and Technologies of Bamako, Bamako, Mali

[3]Pearl Millet Programme, Institute of Rural Economy (IER), Niono, Mali

[4]World Vegetable Center (AVRDC), Bamako, Mali

Email address:

camaraablo@yahoo.fr (A. Y. Camara)

[*]Corresponding author

To cite this article:

Abdoulaye Youssouf Camara, Aminata Dolo, Sory Sissoko, Mamadou Oumar Diawara, Seriba Ousmane Katile, Wubetu Bihon Legesse, Kadiatou Toure, Amadou Hamadoun Babana. Perceptions of Tomato (*Lycopersicon esculentum Mills*) Producers, on Bacterial Wilt and Other Cultivation Constraints, in Major Production Areas in Mali. *Research & Development.* Vol. 3, No. 1, 2022, pp. 11-17.
doi: 10.11648/j.rd.20220301.13

Received: December 25, 2021; **Accepted**: January 11, 2022; **Published**: January 20, 2022

Abstract: The tomato (*Lycopersicon esculentum Mill*) is one of the most important vegetables in the world. It holds an important place in the human diet. Tomatoes are used in many traditional dishes in Mali. They are produced mainly in three regions which are: Koulikoro, Ségou and Sikasso. Despite its importance in the country, its production is subject to many constraints. In order to identify local knowledge on bacterial wilt and other constraints related to tomato cultivation in the major tomato production areas in Mali, a survey was conducted in these areas in 2018. The results of this survey show that the vast majority of tomato growers in the major production areas produce tomatoes between the months of December and March just after the cereal harvest. Several diseases were reported by the producers on the plots, but the most devastating was bacterial wilt (*Ralstonia Solanacearum*), of which all producers have knowledge. According to the producers the causes of bacterial wilt are multiple, it can be caused by acid soils, irrigation water, poor soils, termites etc. The damage is estimated at 100% yield loss by some growers and the majority believe that there is no treatment for *R. solanacearum*. Diseases were identified as major constraints to tomato production in Mali, specifically bacterial wilt.

Keywords: Tomato, Bacterial Wilt, *Ralstonia Solanacearum*, Producer

1. Introduction

Tomato (*Lycopersicon esculentum Mill*) is belonging to the large family Solanaceae. This family includes other species that are also well known [1] such as potato, tobacco, bell pepper, eggplant and pepper. Tomato is one of the most widely grown crops in the world. It is produced in more than 170 countries around the world [2], making it the first vegetable after potato and the second most important global food resource after cereals. It is adapted to a wide range of growing conditions and intended for fresh consumption or industrial processing [3].

Tomato are produced throughout Mali. However, 85% of production comes from three regions: Koulikoro, Ségou, and Sikasso. The largest production area is the Segou region with more than 38% of tomato production in Mali [4]. It is also an important source of income for producers in these production areas. Despite this importance, its production is still low due to the still poorly understood phytosanitary problems that tomatoes are confronted with. Among the phytosanitary problems, bacterial wilt caused by *Ralstonia Solanacearum* is one of the most alarming. It is widespread in all tomato growing areas.

The main objective of this study is to identify indigenous

knowledge on bacterial wilt and other constraints related to tomato cultivation in the major tomato growing areas of Mali.

2. Material and Methods

2.1. Survey Site Choice and Description

To carry out the survey, agents from extension services or research, from the Regional Directions of Agriculture (DRA), from the Regional Directions of the OHVN and from the Regional Centers of Agronomic Research (CRRA) of the IER in the regions involved were solicited, for the choice of the main tomato production areas (Figure 1) and the choice of producers in the different regions.

Koulikoro region; district of Kati (12°44'48.001" North, 8°4'17" West), located 15 km from Bamako, on the Dakar-Niger national railroad line linking Bamako to Kayes and Dakar; and national roads (RN3) Bamako-Kolokani and (RN24) Kati-Négéla-Kita. The climate is Sudano-Sahelian, with a rainfall of between 550 and 850 mm per year. The highest temperatures reach 40°C. The dominant soil types are ferruginous, tropical, hydromorphic. In this district three villages have been designated: Komitan, Sonityni, and Baguinéda.

Ségou region; district of Niono (14°15′09″ north, 5°59′34″ west), has a Sahelian type climate, the average rainfall is 425mm per year. The average annual temperature is 29.7°C. The dominant soil types are brown-red soils consisting of flattened dunes and sandy plains. Two villages have been selected: km39 and Molodo.

Sikasso region; district of Sikasso (11°19'0.001" north, 5°40'0.001" west) has a tropical Sudanian climate, subdivided into two climatic zones: the humid Sudanian zone and the Guinean zone. It is the wettest area in Mali and the one that receives the most water (700 to 1,500 mm/year). The average annual temperature is 27°C. The dominant soil types are gravelly, silty-clay, silty-sandy, clay and hydromorphic. Only one village was chosen: the village of M'Pegnesso.

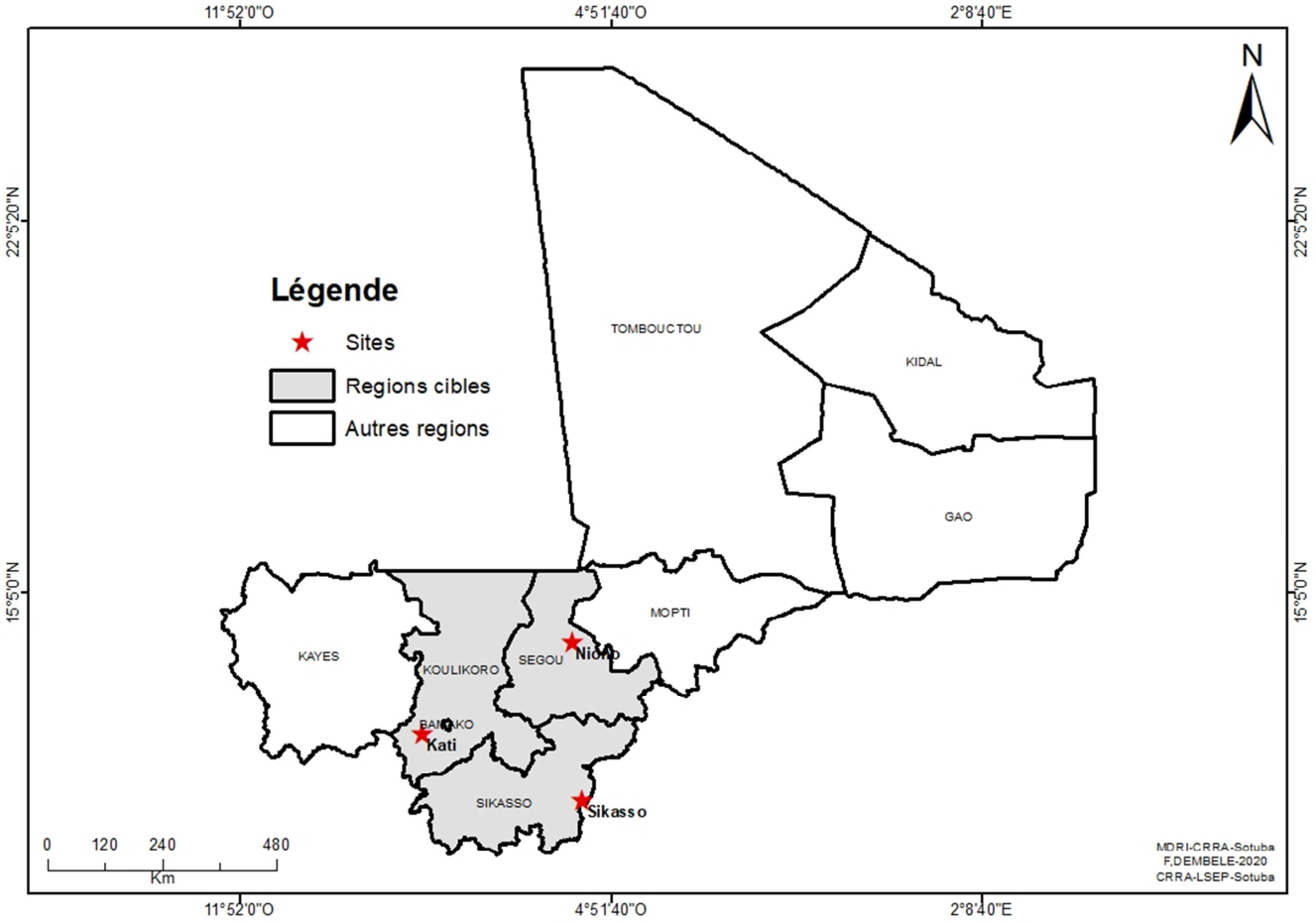

Figure 1. *Map of Mali with target regions and sites.*

2.2. Survey Questionnaire

To perform the survey a questionnaire was developed in 2018. This questionnaire was administered in the form of interviews during field trips to villages in the Kati, Niono and Sikasso districts. The information collected concerned: some characteristics of the respondents' farms, their experiences in tomato production, the periods of tomato production in the areas, the tomato varieties grown, the diseases observed on tomato plots, knowledge of bacterial

wilt (*R. solanacearum*), constraints related to tomato production in the study area, etc.

The survey opened each time with an information session to remind each respondent of the objectives and work methodology, often in the presence of a rural development or agricultural research officer. The respondents responded individually and the interview was conducted according to their availability and in the local language.

The questionnaire was made up of open-ended questions, i.e., questions that are not limited to specific answers and that allow respondents to express their opinions, and closed (fixed) questions that direct respondents to a group of predefined answers, such as yes/no, true/false, or multiple choice.

2.3. Data Collection and Analysis

Data for each survey form were inputted into Microsoft Excel and then imported into IBM SPSS (Statistical Package for Social Science) version 25 software. The data were analyzed using non-parametric statistics and summarized as means, frequencies, or percentages as shown in the tables and graphs in the results section.

3. Results

3.1. Characterization of the Exploitations

The survey involved 80 tomato producers in the study areas, of which 7% were women and 93% were men (Table 1).

Table 1. *Repartition of producers by site.*

Region	District	Village	Number of producers
Koulikoro	Kati	Komitan,	10
		Sonityni,	10
		Baguinéda	10
Ségou	Niono	km39	15
		Molodo	15
Sikasso	Sikasso	M'Pegnesso	20
Total			80

The average age of respondents was 46 years, and have been in tomato production for an average of 22 years (Table 2). The average total area of the producers surveyed is 4 ha and the plots reserved for tomato production have an average area of 0.5 ha (Table 2).

Table 2. *Description of the exploitation.*

Characteristics	Minimum	Maximum	Mean	Standard deviation
Age	30	65	45,6	10,3
Experience in production (years)	5	40	22,2	10,9
Total area of the farm (ha)	0,25	32,00	4,0	7,8
Area under tomato (ha	0,25	1,00	0,5	0,3

3.2. Tomato Production Periods in Mali

Tomatoes are produced during different periods of the year; 40% of growers grow tomatoes between December and March, 25% grow them throughout the year, and only 5% grow them between April and July (Figure 2).

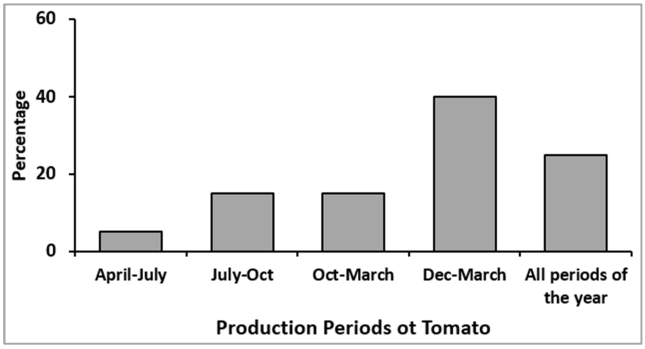

Figure 2. *Tomato production periods in the year.*

3.3. Type of Tomato Varieties Grown

Improved tomato varieties are grown in large part in all regions, used by 65% of producers, followed by hybrid varieties (Figure 3). Only 5% of producers report use of local varieties.

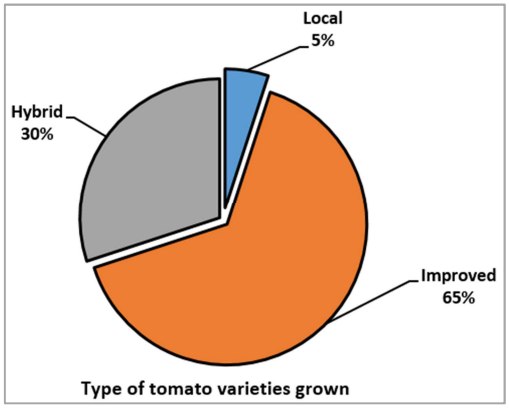

Figure 3. *Type of tomato varieties grown by producers.*

3.4. Origin of Seeds of Cultivated Varieties

The results of the survey reveal that 85% of the seeds come from seed companies, 10% from agricultural research structures

and 5% from exchanges between producers (Figure 4).

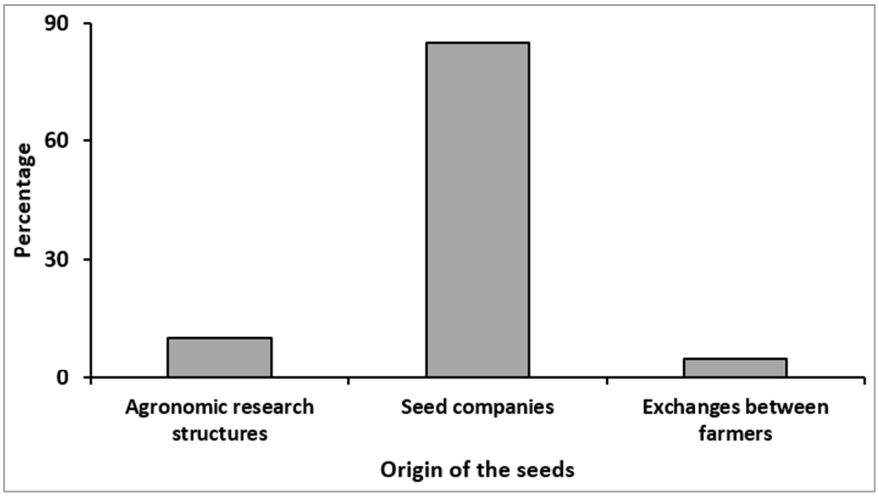

Figure 4. *Origin of seeds of cultivated varieties.*

3.5. Disease and Pest Presence in Tomato Plots

The presence of diseases and pest on the plots was reported by 95% of the producers (Figure 5).

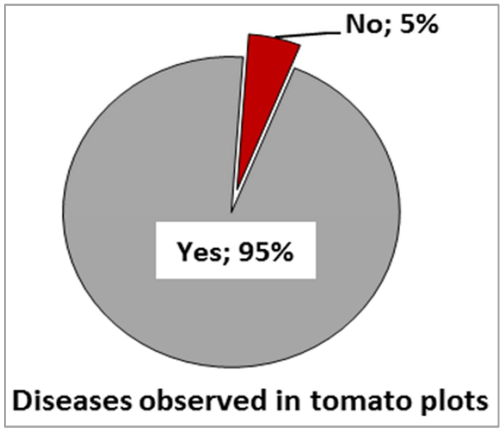

Figure 5. *Presence of diseases and pest on the plots.*

The most reported diseases on the plots were bacterial wilt (37%), followed by virosis (21%) and worms (16%) (Figure 6).

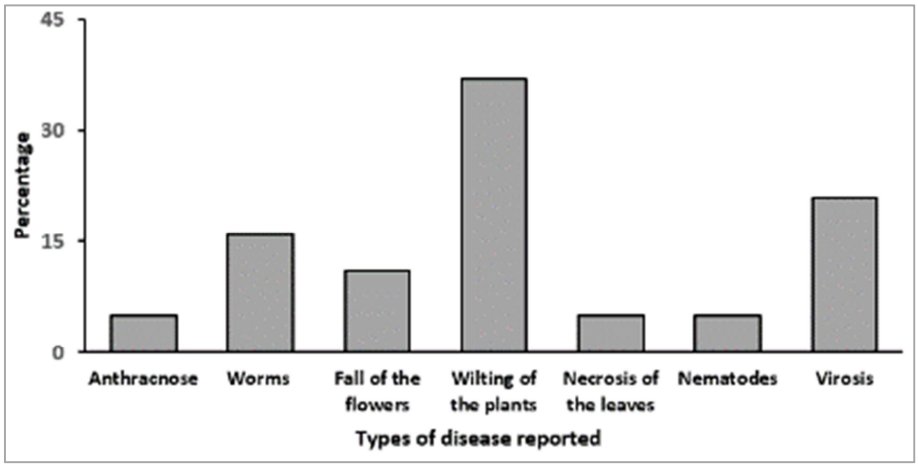

Figure 6. *Types of diseases observed in tomato plots.*

3.6. Producers' Knowledge About Bacterial Wilt (R. solanacearum)

The results of the survey revealed that 97% of tomato growers know about bacterial wilt. Only 3% of producers had no knowledge of *R. solanacearum* (Figure 7).

Producers listed several causes of bacterial wilt presented in Figure 8. Acidic soils were cited by 25% of growers as a reason for bacterial wilt, 15% reported irrigation water, poor soils and termites as reasons. 5% did not provide an answer.

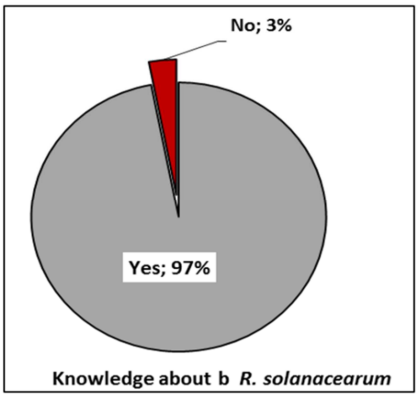

Figure 7. *Producers' knowledge about bacterial wilt (R. solanacearum).*

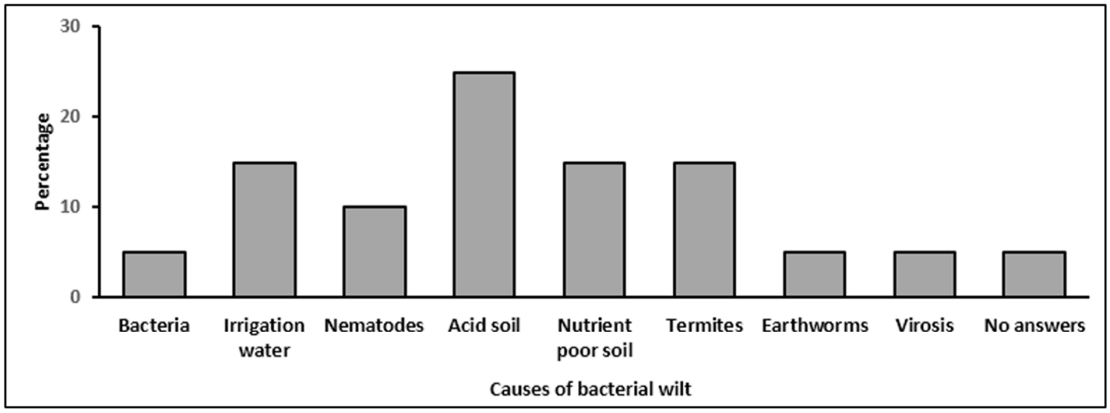

Figure 8. *Bacterial wilt (R. solanacearum) causes cited by producers.*

The results on the estimation of *R. solanacearum* damage by producers are presented in Figure 9. Damage was estimated at 100% yield loss by 10% of growers, 60% of growers estimated damage at 50-75% yield loss, 16% estimated damage at 25-50% yield loss and 14% estimated damage at 5-25% yield loss (Figure 9).

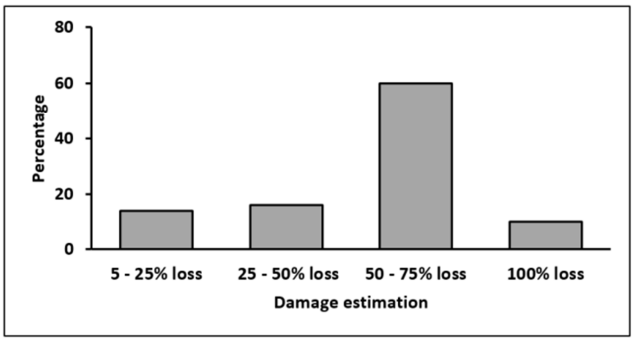

Figure 9. *Producers' damage estimation of R. solanacearum.*

As a means of controlling *R. solanacearum*, producers cited several options, but the large majority (70%) felt that there was no means of fighting this disease; on the other hand, 15% proposed chemical control and 5% biological control, while 5% proposed nematode control or fallowing (Figure 10).

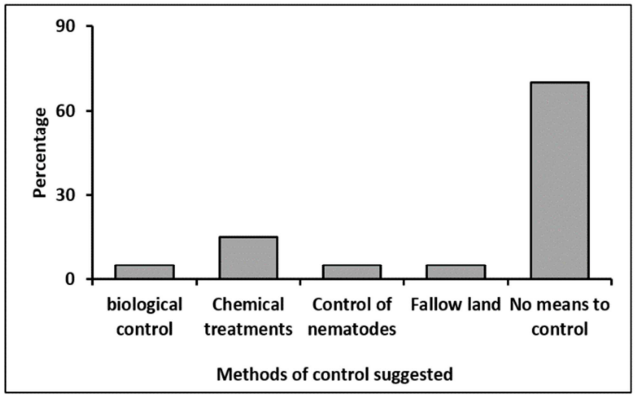

Figure 10. *Methods of control of R. solanacearum suggested by the producers.*

3.7. Other Constraints Related to Tomato Production

Diseases were reported as the main constraint in tomato production by 45% of producers followed by lack of water with 25%, lack of market is cited by 15% of producers, 10% highlighted the lack of training and the lack of adapted tomato varieties was reported by only 5% of producers (Figure 11).

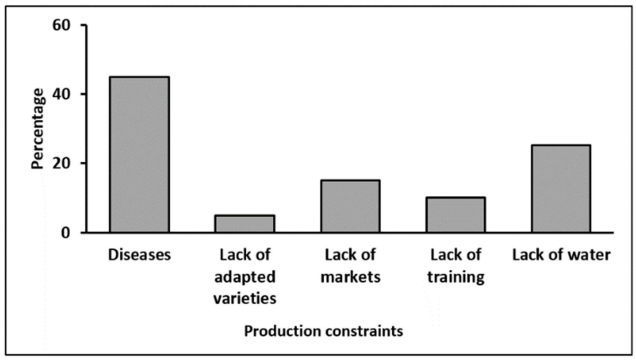

Figure 11. *Tomato production constraints listed by the producers.*

4. Discussion

The results of the survey of tomato growers in the Koulikoro, Segou and Sikasso regions reveal that the average experience of the growers surveyed in tomato production ranges from 5 to 40 years. The size of the tomato plots in the study areas varied from 0.25 to 1 ha. These results highlight that the three zones are the main areas of the old tomato production basins in Mali. These results confirm the study by Maïga [5] on technical-economic reference systems: diffusion of irrigation and production technologies in Mali and by Gergely [6], on the competitiveness of agricultural sectors in Mali.

The survey reveals that the large majority of tomato production occurs between the months of December and March just after the cereal harvest, mainly during the dry season. These revelations confirm the results of Kelly [7] who state that currently, Malian tomatoes for consumption in the country are produced mainly during the dry season, and the studies of Maïga [5] who state that tomato cultivation in Mali gives better results in the cool and dry season (December to July). The tomato varieties grown in Mali are mostly all improved varieties supplied by seed companies. Many of these varieties are not virus resistant and not adapted to all production seasons.

The results of the survey revealed that *R. solanacearum* is known by 97% of the producers, only 3% are unaware of this disease. The 60% of the producers estimate the damage caused by *R. solanacearum* between 50 to 70% of production loss. On the other hand, 10% estimate a 100% loss. According to Cariglia, [8] bacterial wilt can cause up to 90% yield losses in potato and tomato crops depending on the country and the season.

Producers interviewed listed several causes of bacterial wilt due to *R. solanacearum*. Acidic soil was cited by 25% of producers, irrigation water (15%), poor soil (15%), and termites (15%). According to Blancard and Prior, [9], the presence of root-knot nematodes (*Meloidogyne incognita*) in the same soils exacerbates bacterial wilt damage. And also indicate that ferralitic or recent (alluvial, volcanic) clay soils with a kaolinite or halloysite type sheet, at pH between 5 and 7 are the most easily contaminated by *R. solanacearum* because, highly receptive. Runoff and irrigation water leaching contaminated soils constitute another mode of dissemination of *R. solanacearum* [10, 11].

As a method of control against *R. solanacearum* the majority of producers (70%) responded that there is no method of control against *R. solanacearum*, which confirms the statements of Juliette, [12], according to her there is no effective chemical control existing against the bacterial wilt disease due to *R. solanacearum*. The use of chemical products was suggested by 15%, on the other hand 5% propose biological control with Neem extracts and 5% prefer fallow. Lebas, [13], suggests that there are several ways to control the wilt agent *R. solanacearum*. A combination of these methods is ideal, such as the use of resistant/tolerant varieties, fallowing to reduce bacterial inoculum, the use of healthy disinfected materials and the use of organic amendments (cover crops or green manures). The presence of diseases on the plots was reported by 95% of the producers. Tomato diseases were reported as a major constraint to tomato production by the producers surveyed and the most reported disease on the plots was bacterial wilt by 37% of the producers followed by lack of water (drought) by 25% and the lack of a market to sell the production (15%). Kelly, [7], identified two most important constraints: The producers' inability to avoid a market glut by staggering production over time during increased tomato productivity and the prevalence of tomato yellow leaf cupping disease (TYLCV). Tangara, [14], reports that tomato growers also face challenges related to pest attacks, insects, plant diseases and weed invasion. The lack of training was reported by 10% of respondents, the same problem of lack of training was reported by Samassé et al. [15] in their survey with mango producers in the Koulikoro district in Mali. Only 5% of producers reported the lack of adapted seeds as a production constraint. According to Drabo [16], in Mali, on the other hand, market gardeners face constraints related to the availability of water, but also limited access in terms of quantity and quality of seeds.

5. Conclusion

In Mali, the tomato is largely produced. A survey conducted in the three major producing areas (Koulikoro, Segou and Sikasso) in Mali, shows that tomato producers have a long experience in tomato production, more than 20 years on average, and own large tomato production plots. The vast majority of producers produce the tomato between the months of December and March just after the cereal harvest. All of the tomato plots in the surveyed areas are infested with diseases. The most common disease is bacterial wilt, followed by virosis. Almost all the producers have

knowledge about bacterial wilt (*Ralstonia Solanacearum*). According to the producers, there are many causes of bacterial wilt, such as acidic soils, irrigation water, poor soils, termites, etc. The damage is estimated at 100% yield loss by some producers. The majority of producers find that there is no way to control *R. solanacearum*. Diseases are major constraints to tomato production in these areas. Finally, after the diseases, another challenge emerges: that of the lack of organization and remuneration in marketing, with fluctuating and low prices during periods of overproduction.

Acknowledgements

The authors would like to acknowledge West Africa Agricultural Productivity Programme (WAAPP); Rural Economic Institute (IER); University of Sciences, Techniques and Technologies of Bamako (USTTB) for their financial and training support.

References

[1] Naika, S.; De Jeude, J. L.; De Goffau, M.; Hilmi, M.; Van Dam, B. 2005. Tomato growing; production, processing and commercialization. Series Agrodok No. 17. ISBN Agromisa: 90-8573-044-9. ISBN CTA: 92-9081-300-8. Fondation PROTA; Université de Wageningen. 106 p.

[2] FAO. (2013). Analysis of the peri-urban market gardens sub-sector in Bamako (Mali).

[3] Causse M., Caranta C., Saliba-Colombani V., Moretti A., Damidaux R. et Rousselle P. 2000. Enchancement of tomato genetic ressources via molecular markers. Cahiers d'études et de recherches francophones/ Agricultures. 9: 197-210.

[4] Diakite, L. 2004. Survey on the production and needs for vegetable seeds, fruit plants, wheat and forage crops. Direction Nationale de l'Appui au Monde Rural/Projet PAFISEM. Final report.

[5] Maïga, A. 2004. Study on the technical-economic referentials: dissemination of irrigation and production technologies. DTIP- PCDA. Final report. 65p.

[6] Gergely, N. 2002. Study on the competitiveness of agricultural sectors in Mali (mango, green beans, potatoes, tomatoes, sugar peas, sesame and cotton). FAO investment center. 63 p.

[7] Kelly, V.; Carpenter, J.; Diall, O.; Easterling, T.; Koné, M.; McCornick, P.; McGahuey, M. 2005. Options for economic growth in Mali through the application of science and technology to agriculture. United States Agency for International Development Initiative To End Hunger In Africa. 116p.

[8] Cariglia, A. 2007. Preventive control of bacterial wilt in soilless tomato growing. State of knowledge and advice. Pole of Plant Protection, St-Piere (Réunion). ARMEFHOR. 143p.

[9] Blanchard D.; et Prior, P. 2015. Biology, epidemiology. http://ephytia.inra.fr/fr/C/5303/Tomate-Biologie-epidemiologie. Visité le 12 avril 2020.

[10] Farag, N.; Stead, D. E.; Janse, J. D. 1999. *Ralstonia (Pseudomonas) solanacearum* race 3, biovar 2, Detected in Surface (irrigation) Water in Egypt. Journal of Phytopathology 147: 485-487.

[11] Poussier, S.; Vandewalle, P.; Luisetti, J. 1999. Genetic diversity of African and worldwide strains of *Ralstonia solanacearum* as determined by PCR-restriction fragment length polymorphism analysis of the hrp gene region. Appl Environ Microbiol 65: 2184-2194.

[12] Juliette, S. 2017. Agro-ecological control method against bacterial wilt Study report. CIRAD. 26p.

[13] Lebas, M. A. 2010. Evaluation of the remediating potential of 6 plant species against bacterial wilt of tomato (*Ralstonia solanacearum*), under semi-controlled conditions (greenhouse). Report of the training course of interstitial year within the PRAM: September-December 2010. CIRAD. 90p.

[14] Tangara, S. 2011. Vegetable growing: tomatoes rule in Baguineda. http://malijet.com/actualite_economique_du_mali/30382-maraichage_la_tomate.html visité le 02 mars 2020.

[15] Samassé Diarra, Sory Sissoko, Mamadou Oumar Diawara, Bakary Mamourou Traoré, Abdoulaye Sidibe. 2021. Cultivation Practices of Mango (*Mangifera indica*) Varieties Kent and Keitt Planters and the Origins of Orchard Vulnerability to Rainfall Variability in the Koulikoro District. *International Journal of Agricultural Economics*. Vol. 6, No. 4, 2021, pp. 172-180. doi: 10.11648/j.ijae.20210604.14.

[16] Drabo, A. 2017. Contribution of vegetable growing (shallots and potatoes) to farm income in the Office du Niger zone: the case of the Niono agricultural zone. Université Paris-Sorbonne - Master 2.