

REVIEW

STUDY OF SOLANACEAE AND CUCURBITACEAE DISEASES

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INTRODUCTION

Current research at the species of *Cucurbitaceae* and *Solanaceae* families aims to stimulate the progress of fundamental knowledge of plant genetics and physiology, as well as the interactions of plants with the environment, including biotic and abiotic stress (Gómez Tenorio and all., 2016; Laquale and all., 2016; Crescenzi and all., 2016; Agnieszka Skarzynska and all., 2019; Qinsheng Gu, 2019; Brezenu and all., 2019; Kim and all., 2019; Borges and all. 2019; Ortega și colab. 2019). Also the new technologies developed offer possibilities of application in production of the new methods and practices of cultivation in the field and protected spaces (Fahrentrapp and all., 2016; Menzel and Winter, 2016; Karabuyuk and Aysan, 2016; Shojaeiyan and Sahar Aminkar, 2019; Craeve and Marie-Christine Van Labeke, 2019; Zhang and Hao, 2019; Solis and all., 2019; Solis and Madrid, 2019; Shin and all., 2019; Kim and all., 2019; Fracchiolla and all., 2019; Sofie Van Laethem and all., 2019; Oak Jin Lee, 2019; Yi-Ru Lai, and Huang, 2019; Xingping Yang and all., 2019. Xiefeng Yao and all., 2019; Illsup Nou and all., 2019; Bozena Sedlakova, 2019; Yupeng Pan and all., 2019; Elisabeth Abele and all., 2019; Chana-Muñoz and all., 2019, Spania; Fátima Carvajal și colab., 2019, Spania; Liu Wenge, și colab., 2019, China; Aguado și colab., 2019, Spania; Alicia García și colab., 2019, Spania).

MATERIAL AND METHODS

The biological material of this study was represented by species of *Solanaceae* and *Cucurbitaceae* family.

The study was conducted as a review of regarding the diseases and application of new methods in the management of the control of various pathogens, in protected areas and fields, at variety of *Solanaceae* and *Cucurbitaceae* species grow in organical or conventional system, in the current context of climate change. The study are interdisciplinary area with genetics and physiology of plants, as well as the multiple interactions with the environment, including biotic and abiotic stress. Also

the new technologies offer possibilities to modernize the methods and practices of cultivation in the field and protected areas, as well as obtaining valuable results in the implementation of a diverse range of techniques applied in the monitoring and control of the attack of the various pathogens.

RESULTS AND DISCUSSIONS

Many countries have initiated research to obtain results regarding the application of new techniques in the management of the control of various pathogens, in protected areas and in the field, to a diverse range of *cucurbitacea* species cultivated in ecological or conventional system, in the current context of climate change. These include the following topics:

- Study of genetic resources and breeding technologies for increasing disease resistance (Narinder Dhillon, 2019 in Thailand; Abdullah Unlu et al., 2019 in Turkey; Elena Domblides et al. In Russia; Agnieszka Skarzynska et al., 2019 in Poland; Qinsheng Gu, 2019 in China, Brezenu et al., 2019 in Romania ; Kim et al., 2019 in Korea; Borges et al. In Brazil; Ortega et al. 2019 in Mexico).
- Protected crop experiments (Vanninen, 2019, Finland; De Win et al. 2019, Belgium; Fracchiolla et al., 2019, Italy; Saskia Buvsen and Sara Crape, 2019, Belgium; Elings et al., Holland; Craeve et al., 2019 Belgium).
- Mycology (Grumet et al., 2019, USA; Liu et al., 2019, China; De Win et al., 2019, Belgium; Cohen et al., 2019, Israel; Lebeda et al., 2019, Czech Republic; Schouten et al. , 2019, Holland; De Win et al. 2019, Belgium; Su Lee et al., Korea, Sun et al., 2019, China; Jiménez et al., 2019 Spain; Unu et al., 2019, Turkey).
- Fruit quality study in the context of climate change (Li et al., 2019, Israel; Xingfang Gu et al., 2019, China; Liu et al., 2019, China; Mingming Cui et al., 2019, China; Meiling Gao et al. , 2019, China; Penta Pristijono et al., 2019, Australia; Deblina Mitra, et al., 2019 Israel).
- Plant propagation and grafting (Maria Belén et al., 2019, Spain; Bantis et al., 2019, Greece.
- Virology and Bacteriology (Cecile Desbiez and

Hervé Lecoq, 2019, France; De Jonghe et al., 2019, Belgium; Ana Pérez-de-Castro, 2019, Spain; Shahar Nizan et al., 2019, Israel; Mohammad Babadoost, 2019, US.

- Nutrition content and health benefits of *cucurbitaceae* (Patil et al., 2019, USA; Gurubasappa and Ganiger, 2019, India).

- Biostimulators and abiotic stress (Colla et al., 2019, Italy; Ganiger Colla et al., 2019, India; Qin and Leskovar, 2019, USA; Tira-Umphon and Nitwatthanakul, 2019, Thailand; Shojaeiyan and Sahar Aminkar, 2019, Iran ; Craeve and Marie-Christine Van Labeke, 2019, Belgium; Zhang and Hao, 2019, China; Solis et al., 2019, Mexico; Solis and Madrid, 2019 Mexico; Shin et al., 2019, Korea; Kim et al., 2019, Korea; Fracchiolla et al., 2019, Italy; Sofie Van Laethem et al., 2019, Belgium; Oak Jin Lee et al., 2019, Korea; Yi-Ru Lai, and Huang, 2019, Taipei; Xingping Yang et al., 2019, China. Xiefeng Yao et al., 2019, China; Illsup New et al., 2019, Korea; Bozena Sedlakova, et al., 2019, Czech Republic; Yupeng Pan et al., 2019, USA; Elisabeth Abele et al., 2019, Germany; Chana-Muñoz, et al., 2019, Spain; Fátima Carvajal et al., 2019, Spain; Liu Wenge, et al., 2019, China; Aguado et al., 2019, Spain; Alicia García et al., 2019, Spain; Cebrián, et al., 2019, Spain; Carmina, et al., 2019, Spain; Cebrián et al., 2019, Spain; Carmina et al., 2019; Spain, Moya-Hernández, et al., 2019, Mexico; Samira Jandoust et al., 2019, Iran; Rita Mercia Borges et al., 2019, Brazil; Jihve Moon et al., 2019, Korea; Liu Wenge, et al., 2019, China.

Current research in the field of culture and solanaceous protection technologies aims to stimulate the progress of the fundamental knowledge of the genetics and physiology of tomato, pepper and eggplant plants, as well as the multiple interactions with the environment, including biotic and abiotic stress. Also, the new technologies offer possibilities to modernize the methods and practices of cultivation in the field and protected areas, as well as obtaining valuable results in implementing a diverse range of techniques applied in monitoring and controlling the attack of various pathogens (Louws et al., 2016). The studies and experiments are carried out in protected areas and open field, at a variety of solanacea species cultivated in ecological or conventional system, under different conditions, in the current context of climate change (Kara et al., 2016). Diseases in tomatoes, peppers and eggplants can be caused by numerous pathogenic organisms (Aparicio et al., 2016; Frenkel et al., 2016), respectively cellular pathogens (eg. fungi, bacteria, mycoplasmas) and non-cellular pathogens. (for example, viruses and viroids). As respond to the attack of the pathogen, tomato plants, like other organisms, have developed an immune system, in which pathogenic effectors and plant receptor proteins (eg. resistance proteins) play a central role (Moriones and Muñoz, 2016). . With advances in the genomics era, understanding of

plant-pathogen interactions has evolved rapidly. For example, pathogenic genomics has performed genome-wide studies on the structure, function, and evolution of effector pathogens (Yuling Bai et al., 2018). The so-called effectormics offers a functional approach with high efficiency in the study of plant genes associated with effectors, such as resistance genes (R) and sensitivity genes (S). In tomatoes, the "genome of the germplasm" facilitates a resizing of the nucleus and the cytoplasm of cells, to explore the diversity of plant resistance by sequencing and re-sequencing the resources available in the germplasm. This discovery and advanced genome editing techniques have set up new strategies for improving tomatoes with resistance to attack by pathogens. Thus they were revealed:

- Different responses of the plant immune system (T.T.H. Do, 2016 et al., 2016; Gonçalves et al., 2016).

- Possibilities for the practical application of valuable genes in increasing the tolerance or resistance to pathogens of solanaceous plants (Laurindo et al., 2016. Arwiyanto et al., 2016; Pereira et al., 2016);

- Rapid identification of genes for resistance and sensitivity (Moreno-Félix et al., 2016; Janssen et al., 2016).

- New methods for sustainable resistance to pathogens and pests (Jaiswal et al., 2016; Vitti et al., 2016; Fahrentz et al., 2016; Myrta et al., 2016).

- New methods of transmitting resistance to biotic and abiotic stress, with an extended intersection between pathways / pathways for resistance to pathogens and tolerance to abiotic stress (Rufián et al., 2016; Sheikh and Ntoukakis, 2016; Elizondo-Pasten et al. , 2016).

Infectious diseases reduce crop yields by affecting the quality and quantity of the production obtained (Cotes et al., 2016; Samaras et al., 2016; Gunes and Aysan, 2016).

Most pathogens are of fungal origin, Late Blight being one of the main pathogens of tomato crops (Elad, 2016; Deberdt, 2016; Boix-Ruiz et al., 2016; Shtienberg et al., 2016; Grabowskin and Orshinsky, 2016).

Viruses are extremely infectious and easily transmitted by mechanical means, pests, etc. which may cause different symptoms in tomatoes such as: mosaic, light green and / or dark spots on the leaves (Menzel and Winter, 2016; Wintermantel et al., 2016; Wintermantel et al., 2016). For example, the tobacco mosaic virus (TMV) causes deformation of mature leaves and can cause leaflet malformations, reducing the leaf surface (Sui et al., 2016; Seepiban et al., 2016). Certain symptoms of viral infections are characterized by the creasing of the leaves, the deformation of the stalk and the petiole, atypical fruits, without commercial importance, symptoms that can be confused with the phytotoxicity of the herbicides.

Therefore, it is necessary to identify and correctly understand the plant symptoms and the infectious power of the pathogen, in order to apply the appropriate control methods and practices (Bhunchoth, 2016; Kirli et al., 2016; Bhunchoth et al., 2016; Ferriol and et al., 2016). Detecting and correctly identifying pathogens that attack plants are essential for disease control strategies. The commonly used diagnostic methods for the detection of plant pathogens have limitations in the laboratory such as: the requirement of prior knowledge of the genome sequence, low sensitivity of the apparatus having the ability to detect several pathogens simultaneously, etc. The development of advanced DNA sequencing technologies has allowed the determination of total nucleic acid content in biological samples (Fuentes et al., 2018, Chalupowicz et al., 2019). The possibility of using the single molecule sequencing platform from Oxford Nanopore as a general method for diagnosing plant diseases was examined. It was tested by sequencing DNA or RNA isolated from symptomatic plant tissues from several families inoculated with known pathogens (eg, bacteria, viruses, fungi, mycoplasmas). In addition, samples were tested with seed groups containing infections with two or three pathogens, as well as symptomatic samples with unidentified pathogens. The sequencing results were analyzed with Nanopore data analysis tools. In all inoculated plants, the pathogens were identified in real time within one to two hours after the operation of the Nanopore sequencer and were classified at the species or pathotype level. DNA sequencing or direct RNA sequencing of samples with unidentified pathogens were validated by conventional diagnostic procedures (eg PCR, ELISA, Koch test), which supported the results obtained by Nanopore sequencing. The advantages of this technology include: large reading lengths, fast running times, portability and reduced costs, the possibility of use in each laboratory. This study indicates that the adoption of the Nanopore platform will be very advantageous for routine laboratory diagnostics.

The use of varieties resistant to diseases, certified seeds, free from diseases and pests, crop rotation practices, cultural hygiene (elimination of plants attacked from crops), fertilization, ventilation and proper drainage can prevent the occurrence of diseases. Ferriol et al. (2016), considers that preventive and integrated measures are very important to ensure the quality and quantity of production specific to the variety's potential. European Union (EU) regulations have reduced the availability of control measures with chemicals, imposing residue limits, break times or restrictions for certain chemicals considered toxic to humans or the environment. Therefore, selection of disease resistant varieties has become one of the widely used methods to prevent the occurrence and attack of pathogens (Janssen et

al., 2016). Thus, cultivation of resistant varieties can be an effective alternative for integrated pest control (IPC) and integrated pest management (IPM) measures for crops in protected areas and fields (Gómez Tenorio et al., 2016; Laquale et al., 2016; Crescenzi et al., 2016). In order to successfully implement IPM, it is essential to understand the interactions between plants, environmental conditions, pathogens and their effect on plant growth, quantity and quality of production (Jaiswal, et al., 2016; Davenport et al., 2016). Continuous advances in plant pathology studies make this knowledge possible and can contribute to positive results in preventing and controlling disease attack (Vitti et al. 2016; Aguiar et al. 2016). Thus, it has been observed that under certain environmental and technological conditions, plants develop defensive mechanisms to withstand the attack of pathogens (Fahrenttrapp et al., 2016; Menzel and Winter, 2016; Karabuyuk and Aysan, 2016). But a resistance of pathogens to the treatments of control and the diminution of the mechanisms of defense of the plants has been highlighted (Rufián et al., 2016). To help increase the resistance of plants to infections with pathogens nano technologies come with new research in the field. HarpinPss, an elicitor obtained from *Pseudomonas syringae* pv. *syringae*, induces systemic acquired resistance to plants that have not been infected with pathogens. Poor assimilation of harpinPss is a major constraint on foliar application of biopesticide (Nadendla et al., 2018). To improve the bioavailability of the substance, chitosan nanoparticles (H-CSNPs) were combined with harpinPss and tomatoes were treated with the substance obtained. H-CSNPs exhibited high encapsulation efficiency (90%), improved stability ($p < 0.01$) and good harpinPss bioavailability ($p < 0.01$). Treatment with H-CSNPs resulted in sustained induction of peroxidase and ammoniac phenylalanine reducing infection with *Rhizoctonia solani* ($p < 0.05$). Transcripts of several genes involved in defense response had different expressions for harpinPss, CSNP and H-CSNPs treatments. Thus, genes involved in the metabolism of jasmonic acid (JA) were activated during harpinPss and H-CSNP spray treatments, indicating the role of the JA pathway in triggering harpin-mediated defense responses. In addition, CSNPs entry into the cell and harpinPss localization in the chloroplast was tracked using rhodamine-labeled CSNPs encapsulated with harpinPss and GFP-labeled. The results of this study indicate that the use of H-CSNPs is effective for sustained release of harpinPss by modulating the genome of plants for long-term resistance to *R. solani* (Nadendla et al., 2018). Thus, the previous approach of studying only the influence of biotic factors on plant growth is no longer relevant, and complex studies of methods and practices used in protected and conventional or ecological crops are needed (Sheikh et al., 2016; Elad, 2016; Myrta et al., 2016).

In the field of organic farming, foliar disease control in early and late tomatoes is one of the biggest challenges facing organic tomato growers (Hoagland et al., 2016; Samaras et al., 2016; Kanto et al., 2016; Louws et al., 2016). Although resistant hybrids are available, but farmers often like local varieties because they have superior quality and taste. As a result, the current research aims to address this system of culture by: 1 selecting improved tomato cultivars using a participatory approach of conservative selection; 2 improving the understanding of the factors that regulate the induced systemic resistance and the selection of tomato cultivars with multiple forms of resistance; 3 identification of combinations of biofungicides and biostimulators that control foliar diseases while reducing the amount of copper applied (Deberdt, 2016). Thus, in the USA, seed crops were analyzed and controlled in the university research farms of Indiana, North Carolina, Oregon and Wisconsin, USA, between 2015 and 2016. The plants from the best varieties were recombined during winter 2015. The genotypes representing wild or improved breeding lines, modern and advanced breeding lines have been tested at respond to the attack of pathogens under organic farming conditions (Hoagland et al., 2016). Valuable genotypes will be included in RNA-seq experiments to improve understanding of the mechanisms that regulate resistance to disease and adverse environmental conditions and to design markers to improve screening for germplasm collections and to quantify resistance gene expression in studies. land. Advanced propagation lines will be tested for quantitative resistance to leaf diseases, using molecular markers for quantitative resistance to pathogens, by detached leaf analysis. In the current research, the organic biofungicides and the biostimulants are tested alone and in combination, in order to establish the potential in the control of foliar and soil diseases, under the conditions of the new climatic changes. The best combinations are then tested in experiments on production background (Boix-Ruiz et al., 2016).

CONCLUSIONS

This review highlights the latest research in the diseases and application of new methos in the management of the control of various pathogens, in protected areas and fields, at variety of *Solanaceae* and *Cucurbitacea* species grown in organical or conventional system, in the current context of climate change. The study are interdisciplinary area with genetics and physiology of plants, as well as the multiple interactions with the environment, including biotic and abiotic stress. Also the new technologies offer possibilities to modernize the methods and practices of cultivation in the field and protected areas, as well as obtaining valuable results in the implementation of a diverse range of techniques

applied in the monitoring and control of the attack of the various pathogens.

ABSTRACT

Solanaceae and *Cucurbitacea* diseases represent an important limitative factor of crop varieties.

The study include the following topics: study of genetic resources and breeding technologies for increasing disease resistance, protected crop experiments, Mycology, fruit quality study in the context of climate change, plant propagation, biostimulators and abiotic stress, different responses of the plant immune systems, possibilities for the practical application of valuable genes in increasing the tolerance or resistance to pathogens of solanaceous plants, rapid identification of genes for resistance and sensitivity, new methods for sustainable resistance to pathogens and pests, new methods of transmitting resistance to biotic and abiotic stress, with an extended intersection between pathways / pathways for resistance to pathogens and tolerance to abiotic and biotic stress.

This review highlights the latest research in the diseases and application of new methos in the management of the control of various pathogens, in protected areas and fields, at variety of *Solanaceae* and *Cucurbitacea* species grown in organical or conventional system, in the current context of climate change. The study are interdisciplinary area with genetics and physiology of plants, as well as the multiple interactions with the environment, including biotic and abiotic stress. Also the new technologies offer possibilities to modernize the methods and practices of cultivation in the field and protected areas, as well as obtaining valuable results in the implementation of a diverse range of techniques applied in the monitoring and control of the attack of the various pathogens.

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