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World Banana Forum (WBF)

Working Group 01 on Sustainable Production Systems and Environmental Impact

WEBINAR

Global Partnerships in the Fight against Fusarium wilt TR4

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Moderators:

Victor Prada, Secretary General of the World Banana Forum Secretariat (WBF), Food and Agriculture Organization of the United Nations (FAO)

Matheus Lima, Environment and Sustainability Specialist of the World Banana Forum, Food and Agriculture Organization of the United Nations (FAO)

Panellists:

Altus Viljoen, Phytopathology Professor, Stellenbosch University

Andrea Ramos, Technical Director of Plant Health, Colombian Agricultural Institute (ICA)

Carolina Dawson, Banana and Plantain Industry Correspondent, French Agricultural Research Centre for International Development (CIRAD)

Diane Mostert, Head Technical Officer, Stellenbosch University

Diego Caicedo, Director-General, General Secretariat of the Andean Community (SGCAN)

Gabriel Rodríguez, Country Representative in Belize and Paraguay, Inter-American Institute for Cooperation on Agriculture (IICA) and Leader of the Executive Committee of the Global Alliance Against TR4

Leena Tripathi, Director, Eastern Africa Hub, CGIAR's International Institute of Tropical Agriculture (IITA) and Chair of the Steering Committee of the Breeding Better Bananas Programme

Maged Elkahky, Agricultural Officer, Plant Production and Protection Division, Food and Agriculture Organization of the United Nations (FAO)

Matheus Lima, Environment and Sustainability Specialist of the World Banana Forum Secretariat, Food and Agriculture Organization of the United Nations (FAO)

Raixa Llauger, Agricultural Officer, Sub-Regional Office for Central America (SLM), Food and Agriculture Organization of the United Nations (FAO)

Victor Prada, Secretary General of the World Banana Forum Secretariat, Food and Agriculture Organization of the United Nations (FAO)

1. Opening Remarks

On behalf of the **World Banana Forum (WBF) Secretariat**, hosted by the **Food and Agriculture Organization of the United Nations (FAO)**, **Mr Victor Prada**, **FAO**, welcomed all participants to the webinar "Global Partnerships in the Fight against Fusarium wilt TR4", coordinated by the Working Group 01 of the WBF Secretariat. This webinar is part of a series of online webinars that cover key aspects of *Fusarium oxysporum* f. sp. cubense tropical race 4 (Fusarium TR4). The purpose of the webinar was to showcase the work of various alliances and partnerships engaged in combating Fusarium TR4 and to provide insights into their projects, initiatives, and research efforts, highlighting their achievements and innovative approaches with the aim of fostering collaboration and knowledge sharing within the community.

Mr Prada opened the discussion by pointing out that Fusarium TR4 represents a significant threat to banana production worldwide, due to its capacity to spread rapidly and to survive for extended periods without a suitable host. Moreover, no effective control strategies are available, leading to substantial economic losses for the producers. Therefore, identifying potential areas for collaboration, fostering shared responsibility, and engaging in joint efforts are key steps in ensuring the future of banana and plantain production and building a more resilient agricultural sector.

Ms Raixa Llauger, **Sub-Regional FAO Office for Central America (SLM)**, reaffirmed that Fusarium TR4 is a growing concern for all stakeholders within the banana industry due to its devastating potential. FAO has been closely collaborating for over a decade with the WBF, the International Plant Protection Convention (IPCC), the International Regional Organization for Animal and Plant Health (OIRSA), the Inter-American Institute for Cooperation on Agriculture (IICA), the Executive Secretariat of the Central American Agricultural Council (SE-CAC), Alliance Bioversity International – International Centre for Tropical Agriculture (CIAT), the Colombian Agricultural Research Corporation (AGROSAVIA), national and regional plant protection organizations, as well as the public and private sector in Latin America and the Caribbean to implement regional action plans in response to Fusarium TR4. As a result of the disease's recent incursions in various regions of the globe, banana stakeholders have learnt to consolidate their organizational capabilities to be better prepared in the face of new diseases. Shifting climate conditions, economic instability, increasing international trade, and intercontinental travel have inadvertently facilitated the spread of various pests and diseases, posing a significant risk to food security and to local economies. International organizations work towards the transformation of agrifood systems by enhancing surveillance and quarantine measures at entry points, establishing early detection systems, and promoting the adoption of good agricultural practices. These efforts aim to bolster biosecurity capacity in order to ensure a better production, better nutrition, better environment and a better life, while leaving no one behind.

Mr Matheus Lima, **FAO**, set the agenda and introduced the first presentation.

2. Accelerated Breeding of Better Bananas

Ms Leena Tripathi, **International Institute of Tropical Agriculture (IITA)**, first highlighted the importance of bananas as a staple food for several countries. For instance, cooking varieties grown are key to preserve food security in Africa and serve as a valuable source of income. The African population annually consumes 21 kg of banana/plantain per capita. However, there is a substantial gap between the potential and current annual production capacity per year, with a range spanning from 5 to 30 tonnes per hectare. Several factors contribute to this gap, including poor soil quality and the presence of various pests and diseases, such as Black Sigatoka, Fusarium wilt, nematodes, weevils, bacterial wilt, banana bunchy top and Banana Streak Virus (BSV). Fusarium TR4, initially identified in Asia and Australia, has since extended its presence to several countries, posing a serious threat to regions that have not yet been affected.

Ms Tripathi emphasized the holistic approach adopted by IITA to improve banana varieties with a board spectrum of resistance. To counter pests and diseases, different tools are available, each with their respective pros and cons. For instance, the selection of registered varieties available in the Musa germplasm and the use of the conventional breeding programmes have low implementation costs and are not subject to stringent regulations; however, the implementation depends on whether the specific trait of interest is present in the germplasm. On the other hand, biotechnology programmes, based on transgenic and genome-editing approaches, can be developed in the short to medium term. In this case, the cost of developing a new variety is high and the regulations for genetically modified organisms tend to vary from one country to another.

IITA is a renowned centre for banana research engaged in several global partnerships. Its plant breeding programmes for plantain, *Matooke* and *Mchare* – a special Musa variety – are based in Nigeria, Uganda and Tanzania, respectively. Recently, new *Matooke* hybrids were developed in collaboration with the Nelson Mandela African Institution of Science and Technology (NM-AIST) and Tanzania Agricultural Research Institute (TARI) and were officially deployed in 2021 in Tanzania. Furthermore, IITA has initiated several projects aimed at strengthening the banana industry. For instance, Mchare hybrids (e.g. T2070-1) with TR4 resistance are preferred by consumers and have been shown to cause a 64 percent increase in yield. Additional ongoing activities include high throughput screening for Fusarium TR1 and the development of a screening system for Fusarium TR4.

IITA has developed a genome editing platform which relies on CRISP/Cas9-based genome editing to generate disease-resistant banana and plantain varieties. This technique uses multiple gRNAs targeting phytoene desaturase (PDS). The proof of concept within this platform extends to various traits, such as resistance to BSV, which becomes part of the plant's genome as endogenous BSV (eBSV) when the plant is under stress. The focus of this work is to modify the virus genome in order to keep it inactive under stress conditions. These mutants have been evaluated in greenhouses under drought conditions, and the results showed that the plants were either unaffected or slightly affected by the eBSV mutant.

Ms Tripathi pointed out that IITA's work includes a proof of concept for Banana Xantomonas Wilt (BXW) disease, which has had significant impact in six countries across East Africa, leading to yield losses of 60 – 80 percent and estimated losses of USD 2 – 8 billion. All tested cultivated varieties have proven susceptible to the disease, except for the wild type of *Musa balbisiana* (BB), which shows resistance and the disease-tolerant *M. acuminata* subsp. Zebrina, subsp. banksia. So far, efforts have been focused on transferring disease resistance from wild progenitors to cultivated bananas using CRISPR/Cas9. As a result, the banana mutants (DMR6) showed enhanced resistance to BXW, and no negative effect was observed on plant growth. The next step will involve field trials in order to measure yield and trait durability parameters of these banana varieties.

IITA and the partners of the Accelerated Breeding for Better Bananas (ABBB) project have pinpointed several sources of resistance in wild-type bananas and *Mchare* varieties. Moreover, the disease-resistant genes that were identified have been validated. **Ms Tripathi** explained that the gene DMR6 confers broad-spectrum resistance and is upregulated during pathogenic infections. Gene-editing is underway and mutations in the targeted genes have been detected.

In conclusion, Fusarium TR4 is considered the most devastating disease in bananas, significantly affecting food security in banana-producing regions. IITA's work is dedicated to addressing this challenge by developing banana mutants from multiple sources of resistance using a robust screening protocol and its breeding programme, which relies on CRISPR/Cas-based genome editing technologies. In several countries, genome-edited crops with no foreign gene integration are not recognised as genetically modified organisms (GMO), providing a notable advantage to this technology. **Ms Tripathi** acknowledged the valuable contributions of IITA, its partners and funders in the fields of bioinformatics, virology and breeding from IITA.

3. World Musa Alliance

Ms Carolina Dawson, **French Agricultural Research Centre for International Development (CIRAD)**, introduced the World Musa Alliance and its objective to develop banana-tolerant varieties against Fusarium TR4 and other diseases. The genetic improvement of bananas aims to develop better varieties that can support sustainable

cropping systems. These systems must be resilient and ready to cope with a myriad of new challenges, such as the growing threat of pests and disease, climate change, changing demands within supply chains, greater demand for increased productivity, more stringent consumer requirements on fruit quality and ecological production, and the potential banning or imposed reduction of pesticides usage during production.

CIRAD's Breeding Programme aims to create and select new banana varieties for both local and export markets that meet the following criteria. Varieties must be resistant to emerging diseases such as Black Sigatoka and Fusarium TR4 and should be highly productive. Regarding cooking bananas, robustness, pest tolerance, and processing capacity are valuable traits. CIRAD employs conventional breeding techniques and biotechnology to develop a wide range of promising banana hybrids until an ideal candidate is achieved. To do so, a four-stage multidisciplinary breeding plan is implemented. The first stage involves genomic and genetic research. In the second stage, the best potential varieties are selected. The third stage focuses on varietal development and large-scale testing under different environmental conditions to test the adaptation capacity of the selected varieties. In the fourth stage, post-harvest processes are customized to meet specific market demands.

Ms Dawson clarified that the first two stages are conducted at CIRAD's experimental station in Guadeloupe, where activities encompass variety selection, trait characterization, yield assessments, resistance to pests and diseases, commercialization potential and consumer acceptance evaluations. The subsequent stages take place within the World Musa Alliance, involving a network of members with the goal of optimizing pre- and post-harvest processes. In the last stage, selected varieties are categorized based on production method, geographic area, taste and shape.

Moreover, CIRAD relies on its scientific network to assess traits such as agronomical performance, disease resistance, and market acceptance in several experimental stations located in Australia, Guadeloupe, Martinique, the Department of Mayotte, Colombia, Jamaica, Costa Rica, and Cuba. The World Musa Alliance aims to introduce six multi-resistant hybrids that have been carefully screened for resistance against Black Sigatoka, Fusarium wilt tropical race 1 and 4 and banana freckle. Vitropic, a branch of CIRAD based in France, would serve as the only distributor of these hybrids developed by CIRAD. The overarching goal of the World Musa Alliance is to collaborate with researchers and producers in a precompetitive framework, with the goal of expediting research processes and jointly selecting banana hybrids resistant to Black Sigatoka and Fusarium TR4. These hybrids should be compatible with local and international market demands. This initiative brings together the private sector and CIRAD for a 3-year project structured in three stages, with an annual budget that still needs to be defined. In the first stage, banana producers will have access to a wide range of banana hybrids. Vitropic will supply all the plant materials, while CIRAD will provide test protocols, organize data collection, conduct analysis, and present results to Alliance members. In the second stage, a new set of banana hybrids will be made available, with joint financing of the program. The early adopters of the World Musa Alliance program will have a commercial advantage by having early access to these varieties.

The preparation and selection of partners will occur in the second half of 2023, while the testing of banana hybrids is scheduled for early 2024 to the first half of 2025. The second stage is expected to start in the second half of 2025. In this respect, the partners engaged in these activities will commit to (1) providing human and technical resources for testing the hybrids under the Vegetal Material Transfer Agreement, (2) covering additional costs as needed, (3) implementing the field tests in compliance with the Good Experimental Practices Framework overseen by CIRAD, and (4) sharing information with fellow members of the World Musa Alliance. Should a second phase be initiated, partners will participate in the financial contribution for the research and development process. On the other hand, partners will benefit from (1) gaining knowledge about the tested hybrids, (2) receiving processed results from other trial sites, (3) becoming part of a research and development network, and (4) retaining the flexibility to continue or discontinue involvement at the end of each phase. As a final remark, **Ms Dawson** emphasized that if there is a commercialization potential at the end of phase one, partners will have access to these hybrids for commercial purposes.

4. SADC Centre of Excellence on Fusarium Wilt TR4

Mr Altus Viljoen, **Stellenbosch University**, offered an overview of three theories concerning the introduction of bananas to Africa. These theories suggest that bananas were (1) introduced by the Austronesian-speaking people

who settled in Madagascar in the first millennium AD, (2) brought by traders from Arab or Persian regions around the 8th century, or (3) introduced by the Portuguese in the 16th century. In the African continent, the three main groups of bananas include the AAB plantains in West Africa, AAA East-African cooking/beer bananas (AAA-FA) in the Great Lakes area, and the Indian Ocean Complex (edible-AAA, AAA, AB, AAB, ABB).

The banana varieties grown in Africa are closely linked to the diseases affecting them. Fusarium wilt is a prevalent disease in several countries, with Fusarium TR1 being the most widespread in West and Central Africa. Fusarium TR1 and TR2 affect sweet dessert and cooking bananas but do not harm Cavendish, Matooke and plantain.

Fusarium TR4 has been reported in South America, as well as in northern areas of Mozambique and in the Union of Comoros. Fusarium TR4 severely affects Cavendish and sweet bananas. Currently, there is a significant risk of Fusarium TR4 spreading in East Africa due to the cultivation of susceptible varieties, inadequate biosecurity measures, the exchange of planting material and equipment, and the expansion of international trade. The limited financial resources to manage this fungal disease pose a major challenge, highlighting the importance of prevention practices.

Mr Viljoen explained that research at Stellenbosch University focuses on the identification and characterization of Fusarium wilt strains in Africa and Asia, trough the development of molecular markers**.** He highlighted that detecting Fusarium TR4 in water and soil is challenging due to its unequal distribution. Research findings reveal a high diversity of Fusarium TR4 strains, with 57 Vegetative Compatibility Groups (VCGs), instead of the 24 VCGs originally reported. Further advancements are being made in banana breeding research, focusing on various varieties from Asia. Regarding fruit taste, some banana somaclones have been tested in Mozambique, and have shown partial resistance to Fusarium wilt. Mixed cropping systems are common in Africa. Interestingly, partially resistant banana varieties can maintain high productivity in these systems.

Furthermore, Stellenbosch University has been involved in water purification efforts in areas where Fusarium TR4 has been detected and contributed to show that the viability of the fungus decreases in stagnant water due to anaerobic conditions at the water's bottom, where Fusarium spores settle. Additionally, water treatments with chlorine, ozone, UV light, and peracetic acid has proven to be less effective in the presence of soil, emphasizing the need for pre-treatment filtration to remove soil particles.

To prevent the spread of Fusarium TR4 in Southern Africa, Stellenbosch University has devised a comprehensive plan encompassing (1) awareness-raising activities, (2) surveillance, (3) the use of disease-free planting material, (4) research and development, (5) capacity building, (6) biosecurity measures, and (7) political will. The Southern African Development Community (SADC) Plant Protection Technical Committee has convened meetings to formulate contingency plans, courses, and intercontinental trainings, among other actions.

In conclusion, **Mr Viljoen** acknowledges the support of various partners of the SADC Centre of Excellence on the work on Fusarium Wilt TR4 conducted by Stellenbosch University.

5. Global Alliance against TR4 (GAATR4)

Mr Gabriel Rodríguez, **Inter-American Institute for Cooperation on Agriculture (IICA)**, underlined the importance of bananas as the most widely consumed fruit worldwide and as a key source of nutrients. Bananas serve as a staple food for millions of people in West Africa and are a vital crop for more than 20 million smallholders across Africa, Central America, and Asia. However, its production and trade are increasingly threatened by Fusarium TR4 for which no effective control method is currently available. In just three years, this fungus has ravaged 1 500 hectares of banana plantations in Mozambique, and its spread seem to continue unabated.

Despite of the challenges, Fusarium TR4 presents an opportunity for collaborative action. Efforts in plant breeding, capacity-building and biotechnology should account for smallholders, who are particularly vulnerable due to their

dependence on banana trade for food security. In Africa, bananas and plantains are cultivated by 5.7 million households on farms with an average size of 0.7 hectare. In West and East Africa, farmers produce 9.8 million tonnes of banana and 12.4 million tonnes of plantain each year under intensive production systems. In many regions, banana is the most profitable crop and provides a living income for small-scale farmers. Bananas are produced all year round, ensuring a stable income for households. With annual yields averaging 10 to 15 tonnes per hectare, they can generate USD 300 – 400 per tonne or 3,000 – 6,000 USD per hectare, while creating employment opportunities in rural areas. Thus, Fusarium TR4 threatens the source of income and the livelihoods of thousands of workers engaged in the banana industry.

Within the Global Alliance Against TR4, several workstreams have been established, including (1) Prevention and Capacity-building, (2) Banana Breeding and Resistant Varieties Improvement and Genetics, (3) Control Methods, and (4) Policy and Promotion. **Mr Rodríguez** acknowledged the insightful contributions of previous panellists, which covered various topics, including the work on Fusarium TR4, GMO-related controversies and regulatory implications, as well as considerations related to intellectual property. He then highlighted the importance of capacity-building sessions in tackling this disease. Regarding IICA's achievements, the first workstream has provided in-person trainings to 300 farmers in Paraguay, Ecuador, and Colombia, along with online training for 543 participants. The second workstream received an investment of USD 100 000 to update IITA´s laboratory infrastructure, resulting in the generation of over 10 reference genomes and the identification of more than seven sources of genetic resistance.

Mr Rodríguez elaborated on the founding of the Global Alliance Against TR4, which originated from a private sector initiative in 2020, bringing together research institutes, companies, producer associations, Non-Governmental Organizations (NGOs) and various stakeholders of the banana value chain. IICA serves as the Alliance's secretariat, with the goal of fostering collaboration to effectively prevent, contain and manage Fusarium TR4. To do so, the Alliance supports a wide range of activities including prevention, capacity-building, breeding and improvement of resistant banana varieties, control methods and policy development. Additionally, the Alliance's diverse membership permits to cover a wide range of aspects, such as plant nutrition, cultivation methods, cutting-edge research, and global policy trends. However, attracting investments to undertake these actions is challenging, and most of the funding comes from the private sector. **Mr Rodríguez** highlighted the need to raise consumer awareness about the challenges facing the banana industry and announced the launch of an online campaign to educate them on the true costs and externalities of banana production.

6. Questions and Answers Session 1

A participant inquired about the acceptance of gene-edited bananas in certain countries. **Ms Tripathi** clarified that gene-edited bananas are not currently available for commercial purposes and added that there is a non-browning banana variety approved for non-GMO trials in the Philippines.

A question was raised to **Ms Dawson** regarding the access to CIRAD´s banana plant material for field screenings and the potential involvement of smallholder farmers in World Musa Alliance activities. The question also inquired whether a minimum farm size or yield was a pre-required condition to join the program. **Ms Dawson** explained that the organisations that are interested in testing banana plant materials should reach out to the project coordinators at wms@cirad.fr, since they are in the process of building the network for testing these varieties.

Mr Viljoen and **Ms Mostert** were asked about the methods to detect Fusarium TR4 in soil, water and plant tissues in the field. **Mr Viljoen** noted that it is a complex task, and that the sampling process should be carefully considered when conducting field sampling.

Mr Rodríguez received a query regarding potential future capacity-building sessions on Fusarium TR4 and whether they would involve smallholders**.** He clarified that online courses aimed at smallholders are currently available on

IICA's website and that there are ongoing discussions about the possibility of hosting national and regional webinars on the organisation's activities.

7. TR4 Global Network

Mr Victor Prada, **World Banana Forum Secretariat (FAO)**, reiterated the WBF's role as a neutral platform of assembly that brings together a diverse range of stakeholders to discuss relevant issues affecting the banana sector.

Mr Prada informed the participants that the Fourth Global Conference of the WBF will take place on Tuesday 12 and Wednesday 13 March 2024. Moreover, two side events will be held focused on Gender Equity on March 11 and Living Wages on March 14. This event will provide the opportunity for stakeholders to meet, exchange, and collaborate in promoting greater equity, greater sustainability, and shared responsibility within the industry. Critical decisions are set to be made on March 14, 2024, as the WBF has been entrusted with coordinating Living Wages activities in the banana industry.

The WBF supports to the three pillars of sustainability through its interconnected Working Groups (WG): WG01 focuses on Sustainable Production and Environmental Impact, WG02 on Distribution of Value and WG03 on Labour Rights. In 2013, the TR4 Task Force was created, followed by the launch of the TR4 Global Network (TR4GN) in 2020. The TR4GN aims to (1) foster inclusive and open collaboration among stakeholders, (2) facilitate the exchange of information and insights on Fusarium TR4, drawing from WBF members, governments, academia and the banana industry, (3) promote the establishment of partnerships at local, regional and global levels by showcasing efforts of industry members regarding TR4, and (4) raise awareness and support capacity building through informative resources and practical guides.

Mr Matheus Lima, World Banana Forum Secretariat (FAO), underscored the role of the TR4GN as a platform for open collaboration and praised the support of multiple organisations, such as the FAO´s Plant Production and Protection Division (NSP), the International Plant Protection Convention (IPPC), FAO Sub-regional Offices, the Global Soil Partnership (FAO) and the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture. The TR4GN, in partnership with the Plant Production and Protection Division and experts in the field, launched a series of publicly available awareness-raising materials tailored to the needs of the general public, smallholder farmers as well as the National Plant Production and Protection Authorities. The TR4GN hosts a knowledge database on TR4 with over 400 resources that are regularly updated. This platform includes videos, webinars, conferences, awareness-raising materials, as well as scientific publications on biocontrol, antagonistic agents, promising banana varieties, Fusarium TR4 and many other topics. Finally, the TR4GN, in cooperation with members of the TR4 Task Force, has organised several webinars and capacity-building events on Fusarium TR4 diagnosis and outbreaks prevention.

Mr Maged Elkahky, **Plant Production and Protection Division (FAO)**, highlighted FAO's commitment to strengthen the preparedness capacity of countries that have not yet reported the presence of Fusarium TR4. For instance, in collaboration with the Inter-African Phytosanitary Council (AU-IAPSC) and with the support of the United States Agency for International Development's Bureau of Humanitarian Assistance (USAID-BHA), FAO organized two workshops targeting southern and eastern African countries. The first workshop titled 'Strengthening Plant Health Emergency Management Capacities of the SADC Countries' was held in Johannesburg, South Africa, from June 5 to 9 of this year. It focused on Banana Fusarium wilt TR4 and Banana Bunchy Top viral disease and brought together representatives of National Plant Protection Organizations (NPPO) from 16 SADC countries, Stellenbosch University and IITA. During this workshop, representatives from the Union of Comoros confirmed the reports of Fusarium TR4 in the country. The second workshop titled 'Preparedness of SFE Countries for the Threat of Banana Fusarium Wilt Tropical Race 4' was held was held in Nairobi, Kenya, from June 12 to 16. It brought together 31 participants from Eastern African countries including Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, and Uganda, and led to the formulation of a dedicated contingency plans for banana Fusarium wilt TR4.

Under the same project, FAO deployed a team of four experts to assess the situation in the Union of Comoros, gather data to set up an action plan, and provide urgently needed trainings on disease surveillance. The mission garnered significant attention from national authorities due to concern about banana Fusarium wilt TR4 and its threat to food security. The team delivered a training on emergency management and disease surveillance, while assessing the existing infrastructure for handling Fusarium TR4. **Mr Elkahky** mentioned two ongoing projects in Turkey and Lebanon on Fusarium TR4 management and prevention and emphasized the huge potential of capacity building in the fight against this pathogen.

Ms Raixa Llauger, **FAO SLM**, illustrated the actions undertaken in Latin America and the Caribbean, including the Regional Simulation of Action to a Potential Outbreak of Fusarium TR4 held in Nicaragua. In this event, 11 countries and international experts shared their action plans and their main takeaways. A capacity-building training was organised, in which Peru, Venezuela, and Colombia discussed their ongoing initiatives and the current status of Fusarium TR4. In 2023, an additional simulation exercise took place in Ecuador. Additionally, a mission was carried out in Bolivia under the project 'Strengthening Policies, Security Strategies and Food Sovereignty, which encompassed risks related to animal and plant health', and was supported by FAO, IPPC, OIRSA, and the Association of banana producers of Magdalena and Guajira (ASBAMA).

Within the framework implemented in Latin America and the Caribbean, an e-learning course has been created on Good Agricultural Practices and Phytosanitary Risk Management. This course covers prevention, preparedness, and guidelines on safe transfer of potentially infected plant materials. It also includes useful scientific information for action planning, even for areas not yet affected by the pathogen. The course features a case study with practical responses and phytosanitary measures for outbreak containment, bridging theory and action.

Through FAO's Regional South-South Cooperation Mechanisms, events such as the 'Strengthening of Capacities in Diagnosis Systems/Cooperation Actions South-South Colombia-Nicaragua' have involved experts from Colombia and Mexico who provided valuable insights on new diagnosis techniques for Fusarium TR4.

8. Regional Centre of Phytosanitary Intelligence – Andean Community

Mr Diego Caicedo, Director General of the General Secretariat of the Andean Community (SGCAN), highlighted that the Andean Community was established over 54 years ago and involves Bolivia, Colombia, Ecuador, and Peru. This coalition had led to the creation of a free trade zone and the issuance of harmonized, supranational regulations binding its member states. Bananas are among the most exported agricultural commodity within the community, hence safeguarding the banana value chain is a top priority. In 2022, the majority of Andean banana and plantain exports, whether fresh or dried, were primarily from Ecuador (72.6 percent) and Colombia (23.7 percent), contributing to Latin America and the Caribbean's production of over 75 percent of exported bananas.

The Andean Community's banana export markets are diverse. For instance, Bolivia primarily exports to Argentina, Chile, and Uruguay while Ecuador and Colombia have a wide global market presence. Peru, on the other hand, specializes in organic and fair-trade products, mainly destined to the European market. In 2021 and 2022, the export sales of Andean bananas and plantains decreased in value and volume because of several factors, such as rising fertilizer prices, disruptions in the supply chain, and challenges associated with the use of refrigerated containers. Therefore, the banana export value in 2021 was USD 0.48/kg and decreased by 0.7 percent in 2022.

Under the framework of the Andean Community, several action had been undertaken, including (1) implementing phytosanitary surveillance programs for Fusarium TR4, which involve sharing epidemiological bulletins and other information, (2) executing the Regional Standardization Project for the Diagnosis of Fusarium TR4, which encompasses capacity levelling, diagnosis protocol standardization, interlaboratory tests and strengthening of ISO 17025 capacities, (3) providing support for forums, workshops and activities aimed at strengthening the capacity of state member officials, (4) harmonizing technical documentation related to CRIFCAN, and (5) establishing the Regional Centre of Phytosanitary Intelligence.

The Regional Centre of Phytosanitary Intelligence, supported by member states and used by the Technical Committee of Agricultural Health (COTASA), will employ Artificial Intelligence (AI) in the fight against pests and diseases in the region, with a focus on Fusarium TR4. The Centre provides an online platform with epidemiological data that will facilitate disease monitoring and prevention and help set up the Regional Phytosanitary Command.

The establishment of the Regional Centre of Phytosanitary Intelligence unfolded in two phases. The initial phase, aimed at developing the virtual platform, was supported by the Community Initiatives Fund with a budget of USD 218 500. The subsequent phase, focused on the creation of the Centre, received partial funding from the Fund for the Application of Standards and Trade Promotion, totalling USD 1 000 000. Currently, efforts are concentrated on identifying new financial partners to ensure the Regional Centre's long-term economic sustainability. The project is expected to be completed within a two-year timeframe and is actively incorporating feedbacks from various entities, such as the National Health, the National Safety and Food Quality Service (SENASICA), and the International Agricultural Health Organization (OIRSA).

In closing, **Mr Caicedo** expressed his hope for Regional Centre of Phytosanitary Intelligence to achieve the following goals: (1) the implementation of early detection systems for potential phytosanitary emergencies, once the platform is in place, (2) the development of an international network to assess economically important pests in the Andean region, and (3) the capacity building of Andean Community officials in the fields of pest surveillance, monitoring, risk assessment and Integrated Pest Management (IPM).

9. Phytosanitary Risk Management of Musaceae Wilt Foc TR4 in Colombia

Ms Andrea Ramos, **Colombian Agricultural Institute (ICA)**, provided an overview of banana and plantain production in Colombia. The country dedicates 545 458 hectares to banana cultivation, resulting in the production of 6 650 463 tonnes of bananas. This sector is responsible for 168 781 jobs, divided into 42 069 of direct jobs and 126 713 of indirect jobs. In the plantain sector, 28 600 jobs are generated.

Recently, climatic conditions in Colombia have had a cumulative effect on soil humidity levels, leading to direct changes in phytosanitary conditions and affecting the productivity of bananas and plantains. In Colombia, Fusarium TR4 is considered a quarantine pest, and it is found in 11 locations within the Department of La Guajira and in 7 departments of Magdalena, covering a combined area of 3 176.54 hectares. This represents approximately 0.57 percent of the total planted area in Colombia. So far, the disease is only observed in Cavendish bananas and absent in plantains.

Phytosanitary risk management plays a crucial role in preventing new Fusarium TR4 incursions, minimizing the risk of spore dissemination and enhancing the resilience of banana producers. It is based on four fundamental pillars: (1) Risk identification, (2) Prevention (3) Surveillance and monitoring, and (4) Intervention. In Colombia, the risk identification phase spanned from 2010 to 2015, after Fusarium was officially classified as a quarantine disease. A 2017 risk assessment indicated the absence of Fusarium TR4 in the country, but in 2019, new cases emerged, prompting a phytosanitary emergency. In Venezuela, measures were taken to prevent further fungal incursions at national borders following reports of Fusarium TR4 presence in banana plantations. Several national and international organization such as the Association of Colombian banana producers (AUGURA), ASBAMA, the German Agency for International Cooperation (GIZ), AGROSAVIA, the Andean Community, FAO, CIAT & Bioversity International, are actively engaged in these risk mitigation efforts in Colombia. In terms of diagnosis, ICA is assisted by seven laboratories that assists in identifying Fusarium TR4 through conventional PCR, real-time PCR, digital PCR and other molecular techniques. ICA’s bilateral agreements with AGROSAVIA encompass a wide range of subjects, including epidemiological aspects, predisposition factors, propagation materials, biological control, suppressive soils, greenhouse pest management, biosecurity protocols, enhancement of diagnostic techniques, digital PCR, and international collaboration.

Preventive measures in Colombia comprise a national "Clean in, clean out" campaign and a robust regulatory framework called "Prevention, Control, and Surveillance Plan for Fusarium TR4." These measures can be divided into two main categories. The first one includes border protection, analysis, diagnostics, and regulation. Control inspections occur at the Venezuelan border and focus on propagation materials. The second one includes disinfection tunnels for vehicles, control checkpoints, and community centers equipped for vehicle and machinery sanitation at farmgate. Colombia has 47 mobilization control points to examine plant material and biosecurity measures are enforced in banana plantations to prevent soil contamination through clothing, animals, footwear, vehicles, or tools. A partnership with AGROSAVIA has led to the discovery that a 1 percent solution of mono quaternary salt effectively maintains biosecurity standards. Resistance evaluation work is conducted using plant material sourced from CIRAD, including varieties like Ruby, CIRAD 924, CIRAD 931, CIRAD 938, Flhorban 924, Flhorban 931, and Flhorban 938.

Surveillance and monitoring procedures are regulated by the Colombian Resolution 17334, detailing suggested sampling approaches and location-specific surveillance strategies. According to the protocol, when a suspected infected plant is found, the first action involves immediately halting any exchange of plant material and enforcing quarantine measures in compliance with international regulations. Since 2019, ICA has expanded its sample collection activities across all 32 departments, improving the reporting of TR4 incidence. To enhance surveillance, new methods have been introduced through agreements with GIZ, involving the use of drones. Upcoming activities, such as obtaining spectral footprints, are expected for next year.

Ms Ramos pointed out that intervention measures include eradication, insecticide applications, delimitation of affected areas, waterway management, the establishment of single-entry points, and public announcement of quarantines. Currently, the total quarantined area in Colombia covers 3 176.54 hectares. In 2023, three TR4 incursions have been reported, prompting the immediate implementation of quarantine procedures. Interesting, the use of *Trichoderma* spp., *Bacillus* spp., and other bioremediation techniques have yielded positive results against the disease.

Regarding risk communication, activities aimed at strengthening the capacities of farmers, machinery operators, suppliers, transport industry personnel, technical advisors, and the general public, in disease identification and prevention are regularly carried out. ICA is committed to provide technical guidance tailored to the needs of the beneficiaries and to disseminate useful resources on the topic.

ICA's successful management of Fusarium TR4 in Colombia can be attributed to its collaborations with the public and private sectors, including AUGURA in Magdalena and Antioquia and ASBAMA in Cesar, La Guajira, and Magdalena. These partnerships are focused on biosecurity, monitoring, sampling, and risk communication. As previously mentioned, Colombia's approach is centered on prevention (border measures, diagnosis, surveillance systems, fungal genetics, biosecurity for smallholders, planting material, and seed production) and resilience (field trials, quarantine management, land use, and policy compliance). As a result of these actions, ICA’s operational reach has expanded, with a heightened focus on smallholder engagement - 10 percent in the Northern Coast region and 90 percent in the border region with Venezuela. The main priority areas in these regions are biosecurity, monitoring, sampling, and risk communication.

Ms Ramos thanked ICA’s partners for supporting the capacity development of extension workers. Future actions include drafting Letters of Agreement with OIRSA and continuing to respond to emergencies and requests from organizations like the Andean Community and FAO.

10. Questions and Answers Session 2

An attendee inquired about the establishment of the Regional Centre of Phytosanitary Intelligence and its AI tool. **Mr Caicedo** clarified that the project has entered the implementation phase, with an expected two-year timeline

for full implementation. The current objective is to seek global strategic partners to be able to use satellite imagery and to foster partnerships with software and hardware providers to work on imagery and web applications.

Another participant asked about the Andean Community's efforts to contain Fusarium TR4 in areas with smallholders in the Piura Region. **Mr Caicedo** recognised that the Piura region faces significant challenges, especially with regards to pest control and data traceability. Collaborative actions are being taken in partnership with SENASA to mitigate the impact from TR4, involving resource dissemination and capacity-building trainings. There are also joint efforts with international organizations such as IICA, FAO, and GIZ.

It was inquired whether ICA has considered training technicians from producer organizations and private companies to handle the eradication of infected banana plants, and whether the costs of these trainings have already been estimated. **Ms Rodríguez** explained that while technicians undergo capacity-building sessions, they are not trained to carry out this task without the supervision of ICA. She also pointed out that the low number of incursions in 2023 made it easier to effectively control outbreaks. Lastly, she clarified that information on eradication costs for infected plants is not available.

11. Closing Remarks

Mr Lima thanked all the attendees, the WBF Secretariat members and panellists, for their contribution and active participation. He stressed the importance of collective engagement against TR4 and invited all participants to attend the Fourth Global Conference of the World Banana Forum on March 12-13, 2024, along with the two events on Gender Equity (March 11) and Living Wages (March 14).

CONTACT

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World Banana Forum Secretariat
Markets and Trade Division - Economic and Social Development stream
WBF@fao.org

Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy