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ICAR FUSICONT: A QUANTUM LEAP IN AGRICULTURAL TECHNOLOGY

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Introduction

Banana is one of the important crops in many parts of the world, particularly in tropical and subtropical regions which belongs to the family *Musaceae*. Over 70 species of bananas, many of which are not frequently grown for human use, are found in the genus Musa. Dietary fiber, carbs and several vitamins and minerals are all known to be abundant in bananas. The consumption of banana lowers the risk of various chronic diseases, such as heart diseases, stroke, gastrointestinal disorders, certain types of cancer, hypertension, age-related macular degeneration, cataract of the eye, skin conditions, lowering of low-density lipoprotein (LDL) cholesterol, and improved immune function. The most important diseases affecting the banana are *Fusarium sp., Colletotrichum,* etc. *Fusarium* wilt of banana (Panama disease), a soil-borne pathogen is caused by called ***Fusarium oxysporum* f. sp. *cubense***. Around the world, fusarium wilt is a well-known crop disease. Bancroft (1876), who was not aware that he was dealing with a disease, provided the first description of Fusarium wilt in bananas and plantains from Australia which was widely recognized today as one of the most destructive globally in the history of agriculture. The diseases are prevalently distributed in all over the world such as China, Malaysia, Australia and the Philippines. The Fusarium fungus enters immature roots or root bases, usually through wounds. The pathogen results black or purplish brown discolouration on vascular bundles which leads to yellowing of young leaves, wilt, collapse and die. In this article, we briefly discus the pitfalls in the conventional methods of managing the *Fusarium* inciting Panama wilt in banana and the new technology initiated by **"ICAR FUSICONT TECHNOLOGY"** in managing the Panama wilt of banana.

Symptoms

The Panama wilt of banana caused by *Fusarium oxysporum* f.sp. *cubense* exhibit their symptom on both externally and internally. The *Fusarium* fungus enter into the immature rootlets of a plant through the wounds. The external symptom includes the leaf symptom indicates the **circular yellowing in the margin of young leaves**. In severe condition, the leaves become brown in colour causes the petiole to be toppled down around the pseudostem. Internal symptoms are characterized by vascular bundle discolouration. It initiates with yellowing of roots and rhizome vascular tissue. The vascular bundles establish a brown or black colour discolouration.

Typical Vascular Brown

Symptoms of Panama Wilt

Pathogen

Systemic position

Domain	:	Eukaryota
Kingdom	:	Fungi
Division	:	Ascomycota
Class	:	Sordariomycetes
Order	:	Hypocreales
Family	:	Nectriaceae
Genus	:	*Fusarium*
Species	:	*F. oxysporum* f.sp *cubense*

The *Fusarium* pathogen produces a asexual fruiting body called sporodochium from which the macroconidia (long, sickle shaped and 6-8 septate conidia with foot shaped basal cells) and microconidia (small, oval or kidney shaped and 2-3 septate) are produced.

The macro and micro conidia measured about 22-36×4-5µm and 4.82-8.28µm×2.5-3µm respectively. It produces a resting spore called chlamydospores during the absence of host. These may be produced either terminal or intercalary. The pathogen exhibiting a different kind of variation in its morphology and structure under *in vitro* condition.

Macroconidia

Microconidia

Chlamydospores

Epidemiology, spread and survival

In addition to soil characteristics like inadequate drainage, aeration and unfavourable chemical or physical conditions, weather factors including extended wet or dry conditions, temperature extremes, and storm damage also have a significant impact on the wilt disease.

Symptom manifestation is encouraged by an internal water deficit brought on by dry weather or waterlogging. A key element in the development of Panama wilt is temperature. According to Peng et al., the Fusarium wilt pathogen often grows at its fastest rate at 28°C and at its slowest rate at 33°C and lower than 17°C. The pathogen primarily spreads through irrigation and entering into the roots through the wounds created by burrowing nematode *Radopholus similis*, move towards the vascular bundle and restricting the translocation of water and nutrients to the leaves by the formation of cytoplasmic extension of cells called as tylosis. The pathogen on absence of host survives as chlamydospores in the soil until a favourable condition or host occurs.

Management

Generally, the disease causes a severe economic loss of about 60-70% throughout the world. Several methods can be adopted to manage the disease in the field level by handling physical, mechanical, chemical and biological method. Now a days, chemical and biological methods play a prominent role on controlling the diseases. Crop rotation with of banana with non-host crops like maize or legumes which helps in restricting the life cycle of pathogen and reducing disease incidence. Dipping of sucker in the suspension of *Trichoderma viride* along with 500g of wheat bran and sawdust inoculation (1:3) is found to be effective in managing the *Fusarium* wilt of banana. The best way to control Panama wilt disease was to dip the rhizome in carbendazim at a rate of 0.2% for 30 minutes, then drench the plant with a 0.2% solution of carbendazim at 3.5 ml/plant at the 2nd, 4th, and 6th months after planting (MAP) and inject the plant with a 2% solution at 3ml/plant at the 3rd, 5th and 7th MAP either by itself or in combination with the application of calcium carbonate at 10gms/plant at planting.

Pitfalls in Conventional methods of management

The application of chemicals and fungicides might exhibit a drastic change in managing the serious wilt disease of banana. On the other hand, excessive usage of synthetic fungicides for disease management may be detrimental to the health of humans, animals, and plants. Therefore, it is quintessential to control this disease in an alternative, environmentally benign way by focusing on the creation of biofilms and ultimately suppressing this harmful phytopathogen. Hence, the Indian Agricultural Research Institute comes up with a new emerging way of “FUSICONT TECHNOLOGY” to manage the Panama wilt disease incited by *Fusarium* in Banana**.**

Fusicont technology

The term “Fusicont” is derived from two words “FUSI” means *Fusarium* and “CONT” means ‘Control’ which in turn give rise to name “Fusarium Control” which is recently developed technology to manage the Panama wilt (TR4) affecting the Cavendish variety of banana. It causes an economic loss about more than 60% in total. In order to create ICAR FUSICONT, a novel strain of the antagonistic fungus *Trichoderma reesei* (CSR-T-3) cultivated in a patent protected media that is protected by intellectual property rights, a high-stress rhizosphere was used. The formulation is the sole bio-fungicide that works in the nation to control the *Fusarium oxysporum* f.sp. *cubense* Tropical race 4 banana wilt disease. Laboratory validation of the formulation has been conducted under appropriate field experiments in hotspot locations in a methodical manner.

Case studies and in vivo control

About 85 to 92% of the formulation's pre-commercialization evaluations in the hot spot areas of Bihar and Uttar Pradesh, which covered a vast 273 acres, were successful in managing the disease. The application of Fusicont technology effectively controls the Panama wilt disease in banana varieties like Sabari, Malhog, Elakki, Martaman and Karpooravalli. The states like Maharashtra, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Assam, Tripura, Uttar Pradesh, and Bihar have all effectively adopted

ICAR FUSICONT technology to combat the banana wilt disease.

Edge of Fusicont over Chemicals

FUSICONT can improve soil health by encouraging beneficial microbial activity, increasing nutrient availability and fostering plant growth. Chemical pesticides have the potential to alter the soil microbiota, which over time will reduce soil fertility. It is environmentally beneficial, as FUSICONT controls diseases through natural biological processes. However, chemical pesticides have the potential to contaminate soil and water, which could endanger non-target organism and ecosystem. It is consistent with sustainable agriculture methods by lowering dependency on artificial chemicals and fostering biodiversity. Long-term agricultural production and environmental health depend on this. *Trichoderma reesei* and other biological control agents have a lower chance of causing pathogens to become resistant. On the other hand, over usage of chemical pesticides might result in the resurgence of disease as the pathogen tends to mutate over time. Thus the ICAR FUSICONT TECHNOLOGY is eco-friendly sound sustainable, alternative for the conventional chemical fungicide.