

## Bio-immunization to combat Banana *Fusarium* wilt tropical race 4

***In vitro* Bio-immunization technology is a novel tissue culture technology for production of *Fusarium* wilt disease tolerant plants of banana. The process includes engineering the biomolecule into the banana tissue culture plantlets during *in vitro* organogenesis phase. Field studies conducted in the hot spot regions of *Fusarium* wilt at Ayodhya district in Uttar Pradesh and Kattihar district of Bihar revealed that Bio-immunized plantlets were able to sustain the disease incidence to about 98% for a period of 9 months after planting and 85% till harvest.**

**B**ANANA is one of the major important and commercial fruit crops of India known for being in cultivation for ages. Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha, Gujarat, and parts of the North East occupy the prime position in banana cultivation. Recently, banana cultivation has been expanding significantly in Uttar Pradesh and Bihar covering about 69,380 ha and 31,070 ha, respectively. In the recent past, the cultivation of commercial cultivar G9 of banana is being threatened by the outbreak of a virulent strain of *Fusarium* wilt tropical race 4. *Fusarium* wilt caused by *Fusarium oxysporum* f. sp. *cubense* Tropical Race 4 (FOC TR4) is considered to be one of the most devastating complex diseases of banana, limiting its production worldwide. The pathogen is known for its rapid proliferation and devastation of the plantation within a short period causing a huge economic loss to growers. Control of the disease has been a great challenge to researchers across the globe till date.

An outbreak of FOC TR4 has been reported in seven districts of Uttar Pradesh and five districts of Bihar in 2018. The disease nearly affected 8,474 ha in Uttar Pradesh and more than 3,000 ha in Bihar. Farmers effort for mitigating

this disease went to vain and around 30% crop was lost resulting in distress. Management of FOC TR4 is a matter of serious concern as the ability of FOC TR4 to survive in the absence of a host has been a significant factor limiting the success of the management practices like crop rotation, use of chemical fungicides. Selection of resistant cultivars seems to be an effective control strategy against the disease, however, considering the rapid spread of the disease and the dependence of the small and marginal farmers on the crop for economic sustenance prompted to exploit the resources for intensively testing the bio-control antagonists. In an attempt towards successful management, ICAR FUSICONT, a bio-fungicide using antagonistic *Trichoderma reesei* isolate was found effective in managing the disease to about 85%. However, the complex polycyclic nature of the pathogen and its ability to mutate into different Vertical Compatability Groups (VCG's) warranted the need for supportive technologies to build resistance in the host.

### Bio-Immunization

Sustenance of the biological control measures over the long period depends on the supplemental multiple



Production of bio-immunized tissue cultured plants of banana



Tissue culture plants without Bioimmunization

approaches to induce the tolerance in the host. One such effort resulted in the development of a lipo-polypeptide-based biomolecule “BIO-IMMUNE” and the *in vitro* Bio-immunization technology, the process of engineering the biomolecule into the banana tissue culture plantlets during *in vitro* organogenesis. The biomolecule and the process have been patented jointly by ICAR-Central Soil Salinity Research Institute and ICAR-Central Institute for Sub-tropical Horticulture. The current technology is completely different from the bio-priming or bio-hardening process where bacterial and fungal antagonist/endophytes are being treated to the tissue culture banana plantlets in primary and secondary hardening phases of mass multiplication under polyhouse.

#### Advantages of the Bio-Immunization

- The lipo-polypeptide-based bio-molecule has been found to possess antifungal properties that induce the tolerance for biotic and abiotic stress in the tissue culture plantlets.
- Significant increase in the shoot and root biomass and reduction in the duration of the shoot and root culture as compared to the normal media used in business as usual was observed.
- The bio-immunized plantlets were found to exhibit more than 90% of field efficacy against the pathogenic strain of Banana *Fusarium* wilt TR-4 treated plantlets.

#### Field validation and impact of the Bio-immunized banana plantlets

Field studies conducted in the hot spot regions of *Fusarium* wilt at Ayodhya district in Uttar Pradesh and Kattihar district of Bihar revealed that Bio-immunized plantlets were able to sustain the disease incidence to about 98% for a period of 9 months after planting and 85% till harvest. Treatments involving two times drenching of 3% ICAR FUSICONT at 5<sup>th</sup> and 10<sup>th</sup> month after planting of bio-immunized plantlets showed 92 to 96% disease tolerance against the invasion of FOC TR4 suggesting the synergistic role in the management of the disease.

The technology of bio-immunization was demonstrated in 20 farmer’s fields with the immediate history of the FOC TR4 incidence to 30 to 50%. About 22,500 bio-immunized tissue culture banana plantlets were tested in



Bioimmunization plants in fruiting

two hot spot locations (Magalsi village in Ayodhya district and Dighri village in Kattihar district) during 2020-21. Simultaneously, 20 non-adopters were identified whose fields had a similar history of disease incidence ranging from 20-30%. The adopter’s fields were planted with Bio-immunized plantlets while the non-adopters used tissue culture plantlets obtained from private tissue culture firm that was not subjected to *in vitro* immunization. The adopters were also intervened with 2-time drenching of ICAR FUSICONT at 5<sup>th</sup> and 10<sup>th</sup> month after planting while non-adopters followed all standard practices and control measures using Carbendazim 0.5% drenching at 3<sup>rd</sup>, 6<sup>th</sup>, 10<sup>th</sup> month after planting. The disease incidence percentage of the adopters was significantly low (2.77%) compared to the non-adopters (31.58%). The adopters also registered higher average yield per plant and high average net income (₹ 188997) as compared to the non-adopters whose income was reduced due to the high disease incidence.

Sh. Akilesh Yadav of Kattihar district in Bihar who abandoned the banana cultivation because of continuous loss incurred due to the disease, adopted the technology with complete specification in the ray of hope of bringing his land to disease-free banana cultivation, harvested 2,490 plants successfully among the 2,500 plants planted and earned a net income of ₹ 252,660 due to use of bio-immunized plantlets and two-time application of ICAR FUSICONT. Many banana growers from Kattihar, Purnia of Bihar, and Ayodhya district of Uttar Pradesh have adopted the technology in large numbers during the current season 2021-22. Based on the success of the technology, the state government of Bihar has granted a full subsidy to the farmers of Bihar for the use of Bio-immunized plants. Bio-immunized tissue culture technology is a ray of hope for banana growers. The technology has saved livelihood of scores of farmers of Uttar Pradesh and Bihar.

For further interaction, please write to:

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