

Fusarium Wilt in Chili

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ABSTRACT

Chili (*Capsicum annuum* L.) is the most widely grown solanaceous crops in the world. However, their production has reduced over several years due to the attack of various fungal and bacterial pathogens and various abiotic factors. Still, the major constraints in their production are pathogens with fungal etiology, especially the fungal wilt of solanaceous crops. One among the fungal diseases is Fusarium wilt, caused by the *Fusarium oxysporum* has emerged as a serious problem in past decade (Anonymous, 2005). (Singh, 1998) first time reported the wilt disease of chili caused by *Fusarium* spp. *Fusarium oxysporum*, *F. solani*, *F. moniliforme* and *F. pallidoroseum* have been reported as the wilt causing agents from chili growing areas but in India *F. oxysporum* and *F. solani* are the most prevalent species of *Fusarium* found associated with wilt disease of chili (Madhukar, 2004). *Fusarium oxysporum* have been previously identified as the pathogens causing wilt disease in chili. Recently, a new fungal pathogen *F. equiseti* has been reported as the causal agent of wilt disease infecting chili. DNA extraction, PCR amplification, and sequencing were performed on the various diseased plants to isolate the fungus. DNA barcoding using the internal transcribed spacer region (ITS) was used to identify the pathogen followed by the pathogenicity test. Further confirmation of the pathogen was done by sequencing of transcription elongation factor (TEF) and Calmodulin (CAL2).

INTRODUCTION

Fusarium wilt is a plant disease caused by a group of soil-borne fungi belonging to the genus *Fusarium*. This

disease affects a wide range of plants, including vegetables, fruits, and ornamental plants (Wani, 2014). *Fusarium* wilt is

characterized by the yellowing and wilting of leaves, as well as the stunting and eventual death of the infected plant. This disease is a significant concern for farmers and gardeners as it can cause significant crop losses and decrease the overall productivity of agricultural systems.

Fusarium wilt is primarily caused by the fungi *Fusarium oxysporum*, which can survive in the soil for long periods, even in the absence of a host plant. When a susceptible plant comes into contact with the fungal spores, it can become infected. The spores enter the plant through wounds or natural openings and colonize the vascular system, blocking the flow of water and nutrients. This disruption in the plant's vascular system leads to wilting and yellowing of leaves, as well as the eventual death of the plant.

The symptoms of Fusarium wilt can vary depending on the host plant and the specific strain of the fungus. However, common symptoms include wilting, yellowing, and browning of the lower leaves, as well as stunted growth and plant death. Infected plants may also show vascular discoloration, with brown streaks or discoloration visible in the stem or roots. Fusarium wilt is difficult to control once it has infected a plant, as the fungus can persist in the soil for extended periods. Crop rotation, soil sterilization, and the use of resistant plant varieties are some of the strategies employed to manage Fusarium wilt in agricultural and horticultural settings.

CAUSES

Fusarium wilt is a destructive plant disease caused by the fungus *Fusarium oxysporum*. It affects a wide range of plants including tomatoes, potatoes, bananas, and melons. The disease is characterized by the wilting and yellowing of leaves, stunted growth, and eventually, the death of the plant. Understanding the causes of Fusarium wilt is

crucial in preventing and managing this devastating disease.

One of the main causes of Fusarium wilt is the presence of the fungus *Fusarium oxysporum* in the soil. This fungus can survive in the soil for long periods, even in the absence of a host plant. It enters the plant through the roots and colonizes the vascular system, blocking the flow of water and nutrients. This leads to the wilting symptoms observed in infected plants. The fungus can be introduced into the soil through contaminated seeds, infected plant debris, or by certain insects that feed on plant roots.

Another cause of Fusarium wilt is poor soil health and improper cultural practices. Plants growing in nutrient-deficient or compacted soils are more susceptible to the disease. Additionally, overwatering and poorly drained soils create favorable conditions for the growth and spread of the Fusarium fungus. It is important for gardeners and farmers to ensure proper soil preparation, adequate drainage, and appropriate watering techniques to reduce the risk of Fusarium wilt.

Lastly, certain environmental conditions can contribute to the development and spread of Fusarium wilt. The fungus favors warm temperatures between 75-85°F (24-29°C) and high humidity. These conditions promote the growth and reproduction of the fungus, allowing it to infect plants more easily. Moreover, the disease can spread rapidly through contaminated irrigation water or tools. Therefore, it is important to monitor and control environmental factors to minimize the risk of Fusarium wilt outbreaks.

Overall, the causes of Fusarium wilt can be attributed to the presence of the Fusarium fungus in the soil, poor soil health and cultural practices, and specific environmental conditions. By understanding these causes, farmers and gardeners can take appropriate

measures to prevent and manage Fusarium wilt, such as using disease-resistant varieties, practicing crop rotation, improving soil health, and implementing proper irrigation and drainage systems.

MATERIALS AND METHODS

Collection, isolation and identification of Fusarium pathogen from major chili growing areas

Diseased plant samples were collected randomly from the farmer's fields from different locations. In each field row, each 10 meters long were selected randomly. In each row, the total number of plants and number of diseased plants were counted and expressed in terms of percentage. The plants showing symptoms of Fusarium Wilt such as yellowing and wilting in younger leaflets, epinasty, stunting and yellowing of older leaves, brown vascular discoloration of the collar portion of plants were identified and recorded. Percent disease incidence was assessed by counting the number of affected plants out of the total plants.

Isolation of pathogens from infected plants

Diseased chili plants showing typical symptoms of wilt were collected from different locations. The pathogen *Fusarium oxysporum* causing wilt in chili was isolated by tissue segment method from the freshly infected collar portion of the plant. Freshly infected chili stem and collar region were washed thoroughly with distilled water. A small portion of diseased tissues along with a portion of adjacent healthy tissue were cut into small pieces (3 to 5 mm in length) and then surface sterilized with one percent sodium hypochlorite solution for one minute. The pieces then were rinsed thrice with sterilized distilled water. The surface sterilized and rinsed pieces were inoculated aseptically on a sterilized petri plate containing PDA medium

supplemented with streptomycin sulphate to prevent bacterial contamination. The inoculated petri plates were incubated at $25 \pm 2^\circ\text{C}$ for five to six days. When the fungal colony developed, a small bit of single mycelium is transferred on another petri plate containing PDA medium to obtain pure culture. The pure cultures of the pathogen were maintained in PDA slants for further studies. The cultural and morphological characters of the isolates were also studied.

Pathogenicity

Pathogenicity test was carried out using a root dip inoculation method. Seedlings of chili were uprooted gently from the nursery. The roots of seedlings were dipped in a spore suspension of *F. oxysporum* broth containing 10^6 spores per ml for 5 min, dried briefly on a tissue paper and then two seedlings were transplanted into the pots. Four replications were maintained, and plants were irrigated regularly. The disease incidence was calculated twenty days after transplanting. was carried out using a root dip inoculation method. Seedlings of chili were uprooted gently from the nursery. The roots of seedlings were dipped in a spore suspension of *F. oxysporum* broth containing 10^6 spores per ml for 5 min, dried briefly on a tissue paper and then two seedlings were transplanted into the pots. Four replications were maintained, plants were irrigated regularly. The disease incidence was calculated twenty days after transplanting.

SYMPTOMS

Fusarium wilt is a devastating fungal disease that affects a wide range of plants, including tomatoes, bananas, and cotton. It is caused by the soil-borne fungus *Fusarium oxysporum*, which invades the plant's root system and disrupts its ability to absorb water and nutrients (Vidyasekharan, 1981). As a result, plants infected with Fusarium wilt show a

variety of symptoms that can help identify the disease.

One of the most common symptoms of Fusarium wilt is wilting and yellowing of the leaves. This occurs because the fungus blocks the xylem vessels, which are responsible for transporting water and nutrients from the roots to the rest of the plant. As a result, the affected plants are unable to take up enough water, leading to dehydration and wilting of the leaves. The yellowing of the leaves is a result of nutrient deficiency caused by the fungus's interference with nutrient uptake.

In addition to wilting and stem discoloration, another symptom of Fusarium wilt is the presence of small, sunken lesions on the roots of infected plants. These lesions are caused by the fungus infecting the root system and causing damage to the root tissues. As a result, the roots are unable to effectively absorb water and nutrients, leading to the development of these characteristic lesions. Identifying these lesions can help confirm the presence of Fusarium wilt and differentiate it from other diseases with similar symptoms.

Overall, understanding the symptoms of Fusarium wilt is crucial for early detection and management of this destructive disease. By recognizing the wilting and yellowing of leaves, dark brown streaks on the stems, and the presence of sunken lesions on the roots, farmers and gardeners can take appropriate action to prevent further spread and minimize the impact of Fusarium wilt on their crops.

IMPACT

Fusarium wilt is a common fungal disease that affects a wide range of plants, including chili plants. It is caused by the fungus *Fusarium oxysporum*, which enters the plant through the roots and disrupts the flow of water and nutrients (Thoyajakshi Bai, 2018). This leads to wilting, stunted growth, and eventual death

of the plant if left untreated. Fusarium wilt can have a significant impact on chili plants, affecting their overall health and productivity.

One of the main ways Fusarium wilt impacts chili plants is through wilting. As the fungus attacks the roots and blocks the flow of water and nutrients, the plant is unable to take up the necessary resources for proper growth. This results in the leaves and stems of the chili plant becoming wilted and droopy. The wilting may start in specific branches or leaves and gradually spread throughout the entire plant. If the disease progresses, the chili plant may wither and die.

Another impact of Fusarium wilt on chili plants is stunted growth. With the restricted flow of water and nutrients, the plant is unable to grow to its full potential. This leads to smaller leaves, shorter stems, and overall reduced size of the chili plant. Stunted growth not only affects the appearance of the plant but also its ability to produce fruits. Chili plants affected by Fusarium wilt may produce fewer, smaller, or deformed chili peppers, significantly impacting their productivity.

In addition to wilting and stunted growth, Fusarium wilt can also have long-lasting effects on the soil and subsequent crops. The fungus can survive in the soil for extended periods, making it difficult to eliminate completely. This means that even if the infected chili plants are removed, the next batch of plants may still be at risk of contracting the disease. It is crucial to practice crop rotation, use disease-resistant varieties, and implement proper sanitation measures to prevent the spread of Fusarium wilt and protect future chili crops.

PREVENTION AND MANAGEMENT

Fusarium wilt is a devastating plant disease caused by the soil-borne fungus *Fusarium oxysporum*. This disease affects a wide range

of plant species, including tomatoes, bananas, and cucumbers. It is characterized by wilting, yellowing, and ultimately the death of the plant. Fusarium wilt is a serious concern for farmers and gardeners as it can lead to significant crop losses.

Prevention and management of Fusarium wilt are crucial in order to minimize its impact on plants. One of the most effective methods of prevention is practicing good sanitation. This includes removing and destroying infected plants, as well as cleaning tools and equipment to prevent the spread of the fungus. Crop rotation is another important strategy to manage Fusarium wilt. By planting different crops in the same area each year, the fungus is deprived of its host and its population can decline over time. Additionally, selecting and using resistant plant varieties can greatly reduce the risk of Fusarium wilt. Breeding programs have developed resistant varieties of crops that are less susceptible to the disease, providing an effective long-term solution.

In cases where Fusarium wilt is already present in the soil, there are a few management techniques that can be employed. Soil solarization is a process that involves covering the soil with clear plastic during the hot summer months to heat the soil and kill the fungus. Fungicides can also be used, but they should be applied according to the instructions and recommendations of experts to ensure their effectiveness and minimize any negative impact on the environment. Furthermore, maintaining a healthy soil environment through the use of organic matter, proper irrigation practices, and balanced fertilization can help plants withstand the disease. Overall, a combination of preventive measures and management strategies is essential for controlling and minimizing the impact of Fusarium wilt.

CONCLUSION

Chili (*Capsicum annuum* L.) are the most widely grown solanaceous crops in the world. However, their production has reduced over several years due to the attack of various fungal and bacterial pathogens and various abiotic factors. Fusarium wilt is a destructive plant disease caused by the fungus *Fusarium oxysporum*. It affects a wide range of plants including tomatoes, potatoes, bananas, and melons. The disease is characterized by the wilting and yellowing of leaves, stunted growth, and eventually, the death of the plant. One of the most effective methods of prevention is practicing good sanitation. This includes removing and destroying infected plants, as well as cleaning tools and equipment to prevent the spread of the fungus. Crop rotation is another important strategy to manage Fusarium wilt. Fungicides can also be used, but they should be applied according to the instructions and recommendations of experts to ensure their effectiveness and minimize any negative impact on the environment.

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