



## **DISEASE ETIOLOGY AND PATHOLOGICAL FEATURES OF FUSARIUM BASAL ROT (*Fusarium oxysporum* f.sp.*cepae*) IN ONION (*Allium cepa*)**

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### **Introduction**

Olericulture, a branch of Horticulture, deals with the cultivation, production, and management of vegetable crops. In India, vegetables are cultivated over an area of about 11-11.5 million hectares, with an annual production exceeding 200 million tonnes and an average productivity of around 18-19 tonnes per hectare (Indiastat, 2019-20).. This sector plays a crucial role in ensuring nutritional security and enhancing farmers' income. In Tamil Nadu, vegetables are grown in approximately 3.0-3.5 lakh hectares, producing about 6.5-7.0 million tonnes annually, with an average productivity of 20-22 tonnes per hectare (APEDA, 2020), which is comparatively higher than the national average due to better irrigation facilities and intensive cultivation practices.

Onion (*Allium cepa*) is one of the most important vegetable crops cultivated extensively in Tamil Nadu, particularly in districts such as Perambalur, Tiruchirappalli, Namakkal, and Dindigul. The crop occupies an area of nearly 70,000 - 90,000 hectares, with an annual production of around 10-12 lakh tonnes (APEDA, 2020). The average productivity of small onion in the state ranges from 14-16 tonnes per hectare. Tamil Nadu is one of the leading producers of small onion in India, and the crop is highly valued for its culinary importance, storage quality, and export potential. However, onion cultivation is

severely affected by several biotic and abiotic disorders, which significantly reduce yield and onion bulb quality (Schwartz and Bartolo, 1985). Among the biotic disorders, basal rot caused by the fungus *Fusarium oxysporum* f. sp. *cepae* has recently emerged as a major threat in onion-growing regions of Tamil Nadu and India (Mathur and Shukla, 1963, Muthukumar *et al.*, 2022). The disease causes considerable yield losses both under field and storage conditions. In this context, the present article was undertaken to identify the causal organism, Etiological Features, study the symptomatology of onion basal rot disease.

### **Etiology & Pathological Features**

*Fusarium* Basal Rot is one of the most destructive soil-borne diseases of onion under both field and storage conditions. The causal organism, *Fusarium oxysporum* f. sp. *cepae*, belongs to the phylum Ascomycota and family *Nectriaceae*. Species of the genus *Fusarium* are generally saprophytic in nature and survive in soil for long periods. Important species include *Fusarium oxysporum* causing vascular wilt diseases, *Fusarium graminearum* causing grain infections in *graminaceous* crops, and *Fusarium moniliforme* associated with seedling malformation and rot diseases in field and horticultural crops.

The pathogen produces hyaline (colorless), branched, septate mycelium during

the early stage of growth, which later turns pink, brown, or purple upon maturity. It is a polymorphic fungus producing three types of asexual spores under favourable environmental conditions: microconidia, macroconidia, and chlamydospores. Microconidia are single-celled spores mainly involved in initial infection and short-term survival. Macroconidia are sickle-shaped, fusiform or club-shaped spores with 3-5 septa and play a major role in disease development and spread. Chlamydospores are thick-walled resting spores, round to oval in shape, containing reserve food materials and dark pigments such as melanin. These structures help the pathogen survive in soil for many years under unfavorable conditions, with or without the host plant (Kalman *et al.*, 2020).

Chlamydospores (Greek: mantle) may develop terminally or intercalarily on vegetative hyphae, either singly or in chains. Initially attached to the hyphae, they later detach and remain dormant but viable in the soil for long periods without decay. Under favourable conditions, they germinate and infect onion roots with or without help of Nematode.

The infection process begins when the pathogen enters through the root cortex and reaches the vascular bundles. The fungus grows upward through the xylem along with the transpiration stream and produces abundant macroconidia from sporodochia. These sickle-shaped macroconidia obstruct water and nutrient movement within the vascular tissues, resulting in wilting symptoms. In response, the host plant develops a defence mechanism known as tylosis, in which parenchymatous cells enlarge into balloon-like structures to block fungal movement inside the xylem vessels. This mechanism contributes to Host Plant Resistance (HPR). However, the pathogen overcomes this defence by producing secondary metabolites such as fusaric acid and vivotoxins, which degrade tyloses

and damage vascular tissues. Simultaneously, the host plant releases defence-related compounds, including phenolics and Pathogenesis-Related (PR) proteins. The interaction between fungal toxins and host defence compounds leads to necrosis of vascular tissues, causing dark brown discoloration, which is a characteristic symptom of Fusarium wilt and basal rot diseases in onion

### Symptomatology

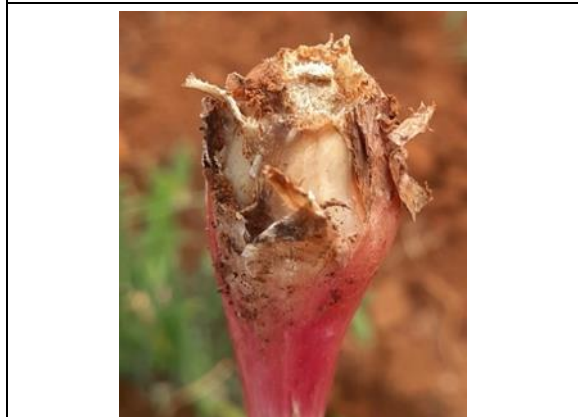
The soil-borne saprophytic pathogen survives in the soil for a long period and infects the crop from the seedling stage up to harvest. Initially, infected plants exhibit yellowing of foliage and gradual drying of leaves, followed by wilting. The drying starts from the leaf tips and progresses downward, accompanied by rolling of leaves. Eventually, the entire plant shows complete drying of foliage. The root system collapses and decays due to the production of the toxin fusaric acid by the pathogen. Infected bulbs develop brown to semi soft watery rot along with whitish fungal mycelial growth on the basal portion of onion bulb. During storage, under favourable environmental conditions, white mouldy fungal growth appears on the basal portion of the onion bulbs, leading to decay of the internal scales (Vijayrao, 2024).



**Yellowing, Curling, and dieback of Infected plant**



**White fungal mycelial growth on basal plate**



**Soft Bulb Rotting on base plate upward**

**Life cycle of Pathogen:**

**Anamorphic stage (Asexual Life cycle)**

The pathogen belongs to the division Ascomycota. Generally, all soil-borne pathogens have two modes of reproduction for completing their life cycle. Under favorable climatic conditions, the pathogen starts asexual reproduction. Initially, the pathogen produces septate mycelium. Under suitable conditions, an asexual fruiting body called a sporodochium is formed from the terminal hyphae, which produces three types of asexual spores: microconidia (single-celled), macroconidia (multi-septate), and chlamydo spores, which are thick-walled resting spores (Mandal *et al.*,2018). The chlamydo spores may be formed terminally or

intercalarily, either singly or in chains. The macroconidia play a major role in disease spread. Chlamydo spores can survive in the soil for a long time, and when favorable conditions occur, they germinate and infect specific host plants.



Pure culture of Pathogen



Micro conidia



Macro conidia



Chlamydo spores

**Teleomorph stage (Sexual Life cycle)**

Under unfavorable conditions, the pathogen starts sexual reproduction and forms a sexual fruiting body called a perithecium, a round to flask-shaped ascoma produced by fungi belonging to the *Sordariomycetes*, on infected plant debris. The perithecia are scattered, sub-conical in shape, and possess an ostiolate opening. When favorable conditions occur, the perithecia develop sac-like or clavate asci. These asci release mature ascospores that are hyaline, two- to three-septate, and usually eight in number per ascus. The ascospores are cylindrical to straight with rounded ends. These ascospores initiate the primary infection in the susceptible host plant under favorable environmental conditions.

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