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Root and Stem Rot/Charcoal Rot: Threat to Sesame Cultivation

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Sesame (*Sesamum indicum* L.) commonly known as 'Queen of oilseeds' is the oldest cultivated oilseed crop particularly in Asia & Africa. It is known with different names in different regions of the world such as til (Hindi), hu ma (Chinese), sesame (French), goma (Japanese), Chhibung (Mizo), gergelim (Portuguese) and ajonjoli (Spanish). Sesame has been cultivated for centuries for its high content of edible oil (50%)and protein (20%) and contains about 47% oleic acid, 39% linolenic acid (Shyu and Hwang, 2002) as well as excellent source of essential minerals (calcium, iron, magnesium, phosphorus, manganese, copper, zinc) and vitamins (thiamin, pyridoxine and folate) (Singh et al. 2016). Sesame oil has excellent stability due to the presence of the natural antioxidants like sesamoline, sesamin and sesamol. Globally, sesame is cultivated in 14 million ha area with an annual production of 6.8 million tonnes. In 2020, India ranked 4th in production after Sudan, Myanmar and Tanzania in the world (FAOSTAT 2020). The area and production of sesame crop is declining despite the potential for increasing the production and productivity of sesame. The reason behind this is various biotic stresses i.e. fungal, bacterial and viral diseases and abiotic stresses like drought, high temperature as well as combination of both biotic and abiotic stresses. The crop is susceptible to number of diseases, such as Charcoal rot/root rot/stem rot of sesame (*Macrophomina phaseolina*), Alternaria leaf spot (*Alternaria sesami*), Cercospora leaf spot (*Cercospora sesame*), Wilt (*Fusarium oxysporum* f.sp. *sesame*), Powdery mildew (*Erysiphe cichoracearum*) etc. Among the fungal diseases, charcoal rot is the most serious because of host plant and pathogen interactions and abiotic stress like high temperature and water stress of the environment causing 5-100% yield losses (Vyas 1981).

Symptoms

The disease symptom starts with yellowing of lower leaves followed by drooping and defoliation. The lower part of stem near the ground level shows dark brown lesions which go up to whole stem and ultimately whole plant dry (Fig. 1). Bark at the collar region shows shredding. The infected stem at later stage showed large number of black pycnidia. The infection may spread to capsules and seeds. The rotten root, stem tissue and capsule also contains a large number of minute black sclerotia.


Fig.1: Root rot infected sesame plants under natural field conditions

Macrophomina phaseolina

Macrophomina phaseolina (Tassi) Goid is a soil-borne fungus present all over the world which is affecting at least 500 plant species of 100 families (Marquez et al. 2021). *M. phaseolina* is a member of the family Botryosphaeriaceae and no sub species or physiological races have been reported so far (Crous et al. 2006). The sclerotial stage of fungus is *Rhizoctonia bataticola*. *M. phaseolina* produces dark brown, septate mycelium showing constrictions at the hyphal junctions (Fig. 2). The sclerotia are minute, dark black and conidia are hyaline, elliptical and single celled.

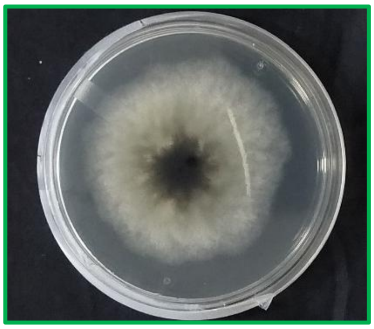

Fig. 2: Growth of Macrophomina phaseolina on PDA medium

Disease Cycle

Microsclerotia of *M. phaseolina* can survive up to 15 years in soil and is the primary source of infection (Gupta et al. 2012). The fungus remains dormant as sclerotia in soil, infected plant debris and seeds. It can infect the roots of the host plant at the seedling stage and once established, the fungus affects the vascular system of plants to disrupt the water and nutrient transport to the upper parts of the plants.

Genetic Diversity

Genetic diversity among *M. phaseolina* isolates has been widely studied using various molecular markers like random amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism (AFLP), Inter-Simple Sequence Repeat (ISSR) and rDNA sequencing from different countries. In some studies, genetic diversity has been associated with geographical locations (Babu et al., 2010; Bakhshi et al., 2010), while in other studies, clustering of data could not clearly differentiate isolates based on geographical origins (Mahdizadeh et al. 2011; Salahlou et al. 2019).

Disease Management

There is no known vertical reported to *M. phaseolina* throughout the world which could inhibits or limit the pathogen infection. The chemical control of *M. phaseolina* is also difficult, since there is no systemic fungicide that move downwards the root. However, systemic and non-systemic fungicides (i.e., carbendazim, difenoconazole, benomyl, azoxystrobin, dazome) at different concentration were evaluated in vitro and in vivo against *M. phaseolina* by various researchers and carbendazim (50 ppm) was found to be most effective agent (Marquez et al. 2021). Some biological control agent like *Trichoderma* spp., *Bacillus subtilis* etc. also reported to inhibit pathogen's growth.

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