

Major Foliar Fungal Diseases of Annual and Perennial Crops: Challenging National Food and Nutritional Security

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ABSTRACT

India's food grain production, which was 82 million tones in 1960-61, reached to about 271.37 million tones in 2018-19. The population, which was 439 million in 1960, rose to 1369 million in 2019. In India, more than 250 million people do not have adequate food despite comfortable food and foreign exchange reserves and high growth in GDP. The problems of declining land, water and labour force engaged in agriculture have impacts on projected food demands for growing population. Cereals, pulses, tubers, vegetables and fruits are important that provide food and nutritional requirements. All these crop plants are susceptible to diseases both in field and post-harvest. Globally, these diseases are responsible for loss of 10% of global food production. Every year, 30% of crops are lost in India due to pests and diseases. The crop loss due to pest and diseases is estimated to be Rs. 90, 000 crores annually. Among these, fungal foliar diseases are economically important.

Keywords: Foliar diseases; *Alternaria*, Major Loss; Cutting-edge; Technologies; Brown spot; Late blight; Southern blight.

INTRODUCTION

Overall, the most important fungal foliar diseases are Late and Early blight, *Alternaria* leaf spot, *Septoria* leaf spot, Tan spot, Powdery mildew, Downey mildew, Leaf rust, Leaf blotch, Anthracnose. Fungal foliar diseases are more severe in the tropical country like India, where congenial humidity and uniform warm temperatures are the norm [1,2].

Economic losses caused by foliar diseases

- Rice is attacked by the *Ascomycetes* fungus *Pyricularia oryzae* (teleomorph *Magnaporthe grisea*), causing rice blast, resulting in losses of 10% to 30% of the crop every year.
- Other cereals are also affected by *P. oryzae* or the similar species *P. setariae*; these include finger millet, *Eleusine coracana*, which, when attacked before grain formation, can suffer complete loss of yield. Such an attack has serious consequences in India where finger millet is an important food security crop.
- A species of *Pyricularia* has also been reported as an increasingly important problem on wheat in addition to rusts.
- Rusts are emerging as major production constraints in

beans, soybeans, grapes, fig and *Chrsanthemum*.

- Members of the downy mildews such as *Peronosclerospora*, *Peronospora*, *Pseudoperonospora*, *Plasmopara*, *Sclerophthora* and *Sclerospora* regularly cause severe diseases on a variety of crops that include maize, sorghum, pearl millet, onion, soybean, cucurbits, and grapes.
- The genus *Phytophthora* belong to *Stramenopila* and *P. infestans* is perhaps its most notorious species, causing losses up to 100 % on potato and tomato crops and incurring heavy fungicidal costs for control measures.

Foliar diseases caused by fungal pathogens can threaten the food security

Some examples

- Potato blight, caused by *Phytophthora infestans*, in Ireland during the 1840s was responsible for death of a million people out of starvation and more than 1.5 million people migrated. Migration of a highly virulent isolate of *P. infestans* from Mexico, favorable weather conditions for epidemic development, lack of resistance in the potato and dependence of Irish population on potato for sustenance are the reasons for this calamity.

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- There are other disasters caused by foliar diseases such as the Great Bengal Famine of 1943 in India. In the Great Bengal famine, 2 million people died due to the high dependence of most of the population on a single crop, rice, which was attacked by the fungus *Cochliobolus miyabeanus* caused brown spot of rice.
- The southern corn leaf blight epidemic of 1970–1971 in the USA, maize crop was completely killed by *Cochliobolus heterostrophus*, although no one died, the agricultural economy was crippled.
- An epidemic of late blight on tomato caused by IN-3, a new population of *Phytophthora infestans*, was recorded in Karnataka during 2008 and is currently spreading to other states causing a serious concern to potato and tomato growers.
- Highly virulent wheat rust fungus race Ug99 discovered in Africa has the potential to famine if aggressive efforts are not taken to create new forms of resistance and other management strategies before the pathogen spreads to India [3].

Major foliar pathogens

- *Alternaria spp* cause serious leaf blight diseases on tomato, potato, cauliflower, cabbage, carrot, coriander, rapeseed mustard, sunflower, sesame and seed species.
- Anthracnose caused by *Colletotrichum spp* is a serious production constraint in chillies, yam, grape, mango, black pepper and cardamom and also known to infect more than 25 hosts of field and horticultural crops.
- *Cercospora* is an economically important pathogen in grain legumes, vegetables, and groundnut, banana and Horticultural crops. *Cercospora* is an economically important pathogen in grain legumes, vegetables, groundnut and banana.

NEED FOR NEW INITIATIVE ON FOLIAR DISEASES

- To develop cutting edge technologies across crops and geographical regions, which would enhance the understanding about the foliar disease?
- To generate eco-friendly and sustainable technologies.
- To develop integrated disease management packages.
- To increase crop productivity, as it is economical, eco-

friendly and suitable for Indian farming systems where agricultural holdings are relatively small.

- The practice of intercropping of diverse crops is common.

CONCLUSION AND TECHNOLOGIES

- A culture repository containing 500 fungal isolates, associated with leaf spot diseases, belonging to *Alternaria* (12 species), *Colletotrichum* (4), *Cercospora*, which has been characterized based on morphology and multi-locus sequence typing has been established. The multi-locus sequences were deposited in the NCBI.
- PCR based diagnostic assays for rapid detection of *A. solani* in tomato, *A. helianthi* in sunflower, *Colletotrichum capsici* in chilli, *C. gloeosporioides* in mango and *C. falcatum* in sugarcane
- AltID - *Alternaria* identification system for rapid identification of *A. solani*, *A. porri*, *A. macrospora*, *A. alternata*, *A. brassicae*, *A. brassicicola*, *A. helianthi*, *A. sesame*, *A. carthami*, *A. ricini*, and *A. burnsii*. The system is based on the IGS-RFLP patterns and secondary metabolite profiling. Digest patterns and secondary metabolite profiles are entered into an analysis package. If a match can be found, unknown isolates may be identified in a matter of hours rather than the several days required for traditional morphological analysis.
- User friendly and computer based *Alternaria* infection prediction model (AIPD) and *Cercospora* infection prediction model (CIPD).
- A seed coating formulation christened as Seedpro based on *Hypocrea lixi* OTPB3 and *Bacillus subtilis* OTPB1 for production of disease free quality vegetables seedlings and formulations of *Pichia guilliermondii* (Y-12 isolate) for management of anthracnose chilli.

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