

Global impact of Puccinia and Leptosphaerulina strains in various host- Review

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ABSTRACT:

As per International Crops Research Institute for the Semi-Arid Tropics (Andhra Pradesh, India) important crops grown in the Indo-Gangetic Plain region of South Asia are rice (*Oryza sativa* L.), maize (*Zea mays* L.), wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), black gram (*Vigna mungo* L.) Hepper), mung bean (*Vigna radiata* L.), pea (*Pisum sativum* L.) and groundnut (*Arachis hypogaea* L.). Most important cereals of India like Moong bean (*Vigna radiata* (L.) Wilczek), Black gram (*Vigna mungo* L.) and Khesari (*Lathyrus sativus*, *L.lathyrus*) are greatly affected by *Leptosphaerulina trifolii*.

The North West Plain Zone is the most important wheat growing area of India and 10.0 million hectares under wheat is the back-bone of the country's food security system. Since the appearance of a new virulence of *Puccinia graminis* f. sp. *tritici* in Uganda in the year 1999, popularly called as Ug99 was widely exposed as a threat to Indian wheat production and to India's food security, a detailed epidemiological study on the relevance of Ug99 to the North West Plain Zone of India was conducted. Apart from this Barley and ground nut (*Arachis hypogaea* L.) are affected by various Puccinia strains such as *Puccinia sorghi*, *Puccinia triticina*, *Puccinia polysora* in which most commonly found is *Puccinia graminis* f. sp. *tritici*.

Keywords: *Leptosphaerulina*, *Puccinia*, review

Introduction:

Fungi are an ancient group not as old as bacteria, the fossil evidence of which suggests them to be around 3.5 billion years old. Some fungi are hidden inside their plant hosts; these are called endophytes. In humans, there are several different types of infections and diseases caused by fungi. The most common are caused by dermatophytes means fungi that colonize dead keratinized tissue including skin, finger and toenails. Rust fungi can cause extensive damage to monocultures of agriculturally and economically important crops globally. *Leptosphaerulina trifolii* and *Puccinia graminis* f. sp. *tritici* are described as endophytic fungi which affects various Indian crops at great extent and ultimately affects economy of the country.

Global impact of Puccinia in various hosts:

Wheat is one of the world's most produced cereal crops and in many countries it is a main source of daily calorie intake (Baloch et al, 1999). The task of preventing severe epidemics in wheat caused by plant pathogens are therefore of major concern for food security. Cereal disease management has mainly relied on deployment of resistant host varieties and fungicide application (Roelf et al. 1992; Chen 2005; Walter et al. 2012). The use of host resistance is the more environmental friendly and practical way to control disease (Hallwork 2009). It further has an economical advantage and in many developing countries the use of fungicides is not an option due to cost and availability. Development of cereal varieties that carries resistance against important diseases is thus a main focus for plant breeders and researchers (Johnson 1992; Pratt and Gordon 2006).

The most important diseases on wheat include fungal pathogens within the group of rust fungi (Garg et al, 2014). Wheat is a host for three rust fungi *Puccinia graminis*, *Puccinia triticina* and *Puccinia striiformis* causing the diseases stem rust, leaf rust and yellow rust, respectively (Roelfs and Bushnell 1985). Both historically and recently all three rust pathogens have caused severe epidemics. The success of these pathogens in an agricultural environment is due to their ability to spread by the wind over long distances and their ability to adapt to host resistance (Brown and Hovmoller 2002; Kolmer 2005). Many examples exist where these pathogens have overcome new resistant 11 wheat varieties only few years after they were first used at large scale in the field (Kolmer et al. 2004).

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Turfgrass is an important component of athletic fields, home lawns, parks, and commercial environments around the world. In the United States, turfgrass establishment and maintenance is one of the largest agricultural industries, contributing more than 40 billion dollars to the national economy each year.

In the temperate United States, *P. coronata* (crown rust), *P. graminis* var *graminis* (stem rust), *Puccinia striiformis* Westend. (stripe rust), and *Puccinia recondita* Roberge ex Desmaz. and *Puccinia brachypodii* G. Oth, (leaf rusts), are considered the most prevalent rust pathogens of turfgrasses (Smiley et al., 2005). These fungi have long been considered host specific, with isolates of *P. graminis* causing disease on fescues, ryegrass, bluegrass, and Timothygrass (*Phleum* sp.), *P. striiformis* causing disease on wheatgrass (*Agropyron* sp.), bentgrass (*Agrostis* sp.), fescues, ryegrass, Timothygrass, and bluegrass, *P. coronata* causing disease on wheatgrass, bentgrass, fescues, ryegrass, paspalums (*Paspalum* sp.), and Timothygrass, and *P. recondita* and *P. brachypodii* causing disease on wheatgrass, bentgrass, fescues, ryegrass, and bluegrass (Smiley et al., 2005). In the southern United States, where warm-season turfgrasses predominate, multiple rust fungi are reported to infect bermudagrass (*Cynodon* sp.), paspalums, and zoysiagrass (*Zoysia* sp.), and these pathogens appear to be host specific (Smiley et al., 2005). Additionally, *Puccinia*, *Physopella*, and *Uromyces* species have been described from Asia, Europe, and South America, many of which are

considered host specific on grasses only found in those regions (Smiley et al., 2005). However, caution must be used when considering the host range for graminicolous rust species, as cross-infectivity has been reported with isolates of *P. graminis* obtained from perennial ryegrass and tall fescue (Pfender, 2009a, 2001b).

Global impact of *Leptosphaerulina* in various hosts:

The genus *Leptosphaerulina* comprises roughly twenty-five species that are endemic to North America, South America, Europe, Asia, Africa, and Australia (Irwin and Davis, 1985; Graham and Luttrell, 1961; McAlpine, 1902). The genus was erected by Daniel McAlpine in 1902, designating *Leptosphaerulina australis* as the type specimen.

Leptosphaerulina leaf blight is presently thought of as a common problem in the humid areas of the United States, occurring mostly on creeping bentgrass (*Agrostis stolonifera* L.), Kentucky bluegrass (*Poa pratensis* L.), and perennial ryegrass (*Lolium perenne* L.) (Shurtleff, et al., 1987). Other turfgrass species described as being susceptible include annual bluegrass (*Poa annua* L.), colonial bentgrass (*Agrostis tenuis* Sibth.), red fescue (*Festuca rubra* L.), tall fescue (*Festuca arundinacea* Schreb.), annual ryegrass (*Lolium multiflorum* Lam.), and bermudagrass (*Cynodon dactylon* (L.) Pers. (Couch, 1995). The initial symptom described for the disease is leaf tip yellowing. The blighted area shifts from yellow to brown and expands toward the leaf sheath. In severe cases individual blades become necrotic and shrivel. Minute brown pseudothecia develop on the dead tissue (Couch, 1995; Watschke, et al., 1995; Smith et al., 1989; Shurtleff et al., 1987; Smiley, 1987). In some instances, water-soaked spots that quickly turn white may also be present. These bleached spots are similar to lesions caused by dull mowers, frost, or heat stress (Shurtleff et al., 1987; Smiley, 1987). Symptoms of *Leptosphaerulina* leaf blight often resemble those of *Ascochyta* leaf blight, dollar spot, *Nigrospora* leaf blight, *Pythium* blight, and *Septoria* leaf spot (Shurtleff et al., 1987).

Leptosphaerulina australis was also reported by McAlpine to occur on plants in the genera *Dolichos*, *Poa*, and *Lolium* (McAlpine, 1902). The first and only discovery of an anamorphic stage of *Leptosphaerulina* was reported in a study from the Karoo region of South Africa. *Leptosphaerulina chartarum* was described to be the teleomorph of *Pithomyces chartarum* (Berk. and Curt.) Ellis, a pathogen of caltrop (*Tribulus terrestris* L.) (Roux, 1986). Luttrell (1979) stated that species within the genus may suppress anamorphic stages because the teleomorphic stage fulfill the asexual niche by being homothallic, maturing quickly, having repeated cycles, and serving as a dispersal stage.

Species in the genus *Leptosphaerulina* (Pleosporales) are filamentous ascomycetes that produce dark colored pseudothecia. The development and morphology of the pseudothecial centrum in the genus is consistent with Luttrell's *Dothidea*-type (Luttrell, 1951). The *Dothidea*-type centrum is characterized by darkcolored pseudoparenchyma cells enclosing an aparaphysate locule containing a fascicle of asci (Luttrell, 1951). Asci of *Leptosphaerulina spp.* are shortly clavate to saccate, and have bitunicate wall structure (Graham and Luttrell, 1961; McAlpine, 1902). Bitunicate asci are characterized by an inner extensible wall (endotunica) that ruptures through an outer inextensible wall (ectotunica). Ascospores are forcefully discharged through a pore at the vertex of the endotunica (Luttrell, 1951). Ascospores of *Leptosphaerulina* are hyaline to brown in color and ellipsoid, cylindrical, or oblong in morphology. They are phragmosporous or muriform with zero to several longitudinal septa and at least one transverse septum (Graham and Luttrell, 1961; Inderbitzin et al., 2000).

Discussion:

As fungi is certainly the best studied kingdom in eukaryotic organisms, there is enormous potential to combine molecular and morphological data for accurate identification of fungal species and also to resolve any type of controversy in species identification.

The emergence on identifying rare but fungi has placed a growing diagnostic burden to clinical microbiologists. Therefore, the accurate identification of these etiologic agents is critically important and a precise identification method has to be designed as soon as possible.

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