*Trichoconiella padwickii (*Stackburn disease)

1. Identity: ***Alternaria padwickii***

Figure 1. Photo by Donald Groth, Louisiana State University AgCenter

Preferred Scientific Name:

- *Trichoconiella padwickii* (Ganguly) B.L. Jain 1976

Preferred Common Name:

- Stackburn disease

Synonyms:

- *Alternaria padwickii (Ganguly) M.B. Ellis 1971*
- *Trichoconis padwickii Ganguly 1948*

Taxonomic Position:Class: Dothideomycetes **Order:** Pleosporales **Family:** Pleosporaceae

2. Hosts/species affected

Axonopus compressus (carpet grass), *Eucalyptus tereticornis* (forest red gum), *Marsilea quadrifolia*, *Oryza sativa* (rice), *Parthenium hysterophorus* (parthenium weed) , *Pennisetum glaucum* (pearl millet), *Sorghum bicolor* (sorghum), *Urochloa decumbens* (signal grass) (CABI,2016) *Saccharum sp*. (Poaceae) (USDA,2010).Main host though is rice(*Oryza sativa).*

3. Growth stages affected

Seeds, Glume, Seedling, Seedling stage, Leaves, stems, fruits (CABI, 2016).

4. Biology and Ecology

Trichoconiella padwickii is an asexually reproducing fungus that infects seeds of rice. It is one of several fungi responsible for seed discoloration, seed rot and seedling blight, but has also been detected as a sheath-rotting pathogen (Naeimi et al., 2003). The recovery of *T. padwickii* conidia from the air in a rice [Oryza sativa] field (Sreeramulu and Vittal, 1966) supports the suggestion of Tisdale (1922) that the fungus survives in soil or crop debris, presumably as sclerotia and mycelium that are embedded within host tissues. Wild grasses have been found to be infected (Padwick, 1950; UK CAB International, 1984; Mendes et al., 1998) and may be another source of inoculum for the ripening rice. Numbers of airborne conidia released were highest between 6.00 and 12.00 h and, on a seasonal basis in India, greatest conidial densities occurred at the time when ears were ripening (Sreeramulu and Vittal, 1966). Maximum growth in culture occurs at 26-28°C (Chuaipraisit, 1976), but there are no reported data on the conditions that stimulate sporulation in culture or in the field. Rotem (1994) noted that, although microsclerotia have been reported from a few species in the genus, even those records are rare and most information on the survival of Alternaria-like species relate to conidia and mycelium. The role of sclerotia in the epidemiology of this pathogen may be unique. Tullis (1936) indicated that the pathogen gains entry to seeds through the glumes and attacks the kernel before the rice [Oryza sativa] is mature. The fungus can be isolated from the glumes, endosperm and embryo of infected seed of susceptible varieties (Srinivasaiah et al., 1984). Seedborne incidence was favoured by high rainfall and by small fluctuations in temperature and relative humidity (Abdul-Kair et al., 1988). This pathogen is also extensively seedborne and its transmission to seedlings has been demonstrated under laboratory test conditions (Mathur et al., 1972).

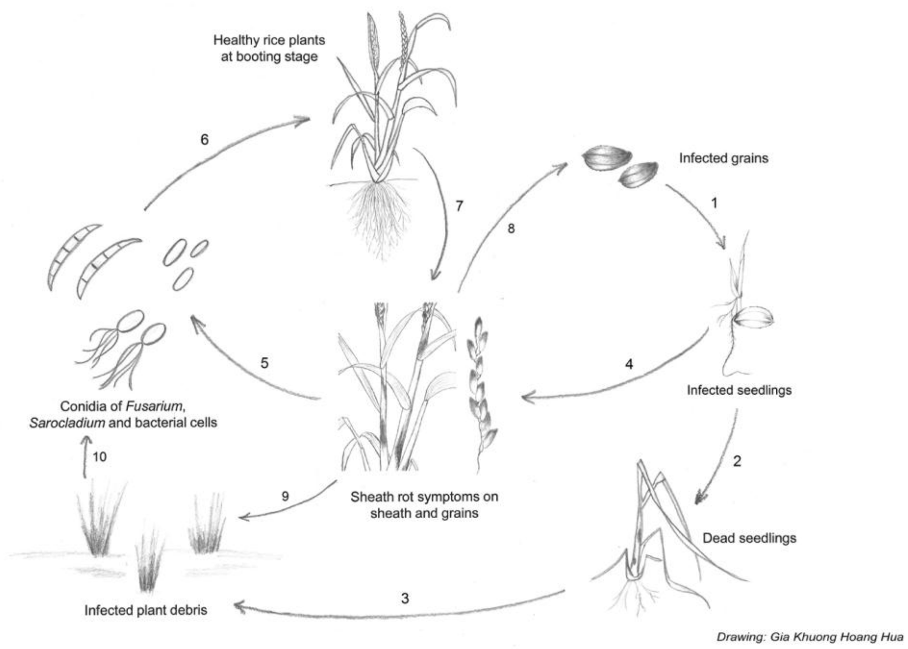

Figure 2. Disease cycle for *A. padwickii* by Gua Khuong

b) Symptoms

This seed-borne fungus causes pre- and post-emergence seed rot (Srinivasaiah et al., 1984). After emergence, small dark-brown lesions may occur on the roots, the coleoptile or the early leaves. The parts of the seedling above lesions are blighted or the whole seedling dies (Padwick, 1950; Rush, 1992). Spots on later leaves, only occasionally seen, are oval to circular, 3-10 mm diameter and tan, later becoming grey to white with a narrow, dark-brown border (Padwick, 1950). In the "stack burn" phase of the disease, spots on glumes are pale brown to white or faintly pink or reddish-brown, usually with a darker border (Groth, 1992). Infected grain is dark coloured, chalky, brittle, and/or shriveled, with reduced viability (Lee, 1992b; Groth 1992). The small black sclerotia appear in the centre of lesions on all infected parts (Ou, 1985) and may be numerous in infected grains (Padwick, 1950).

T. padwickii is one of a number of fungi found associated with the panicle rice mite, *Steneotarsonemus spinki*, which damages rice grains worldwide and has recently been rediscovered in the rice-growing states of the southern USA (Hummel et al., 2009).

Feeding by rice bugs such as *Leptocorisa oratorius* was considered to enhance infection of the grain by fungi including *T. padwickii*, in the Philippines (Lee et al., 1986). A "loose vector relationship" between the rice stink bug, *Oebalus pugnax* and fungi causing grain discolouration, such as *T. padwickii*, that is introduced during feeding has been reported (Lee et al., 1993).The fungus, *T. padwickii* , is however not vector transmitted.

Figure 3. Dark-brown lesions on the leaves :Photo by Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Figure 4. Dark-brown lesions on the leaves : Photo by Donald Groth, Louisiana State University AgCenter, Bugwood.org

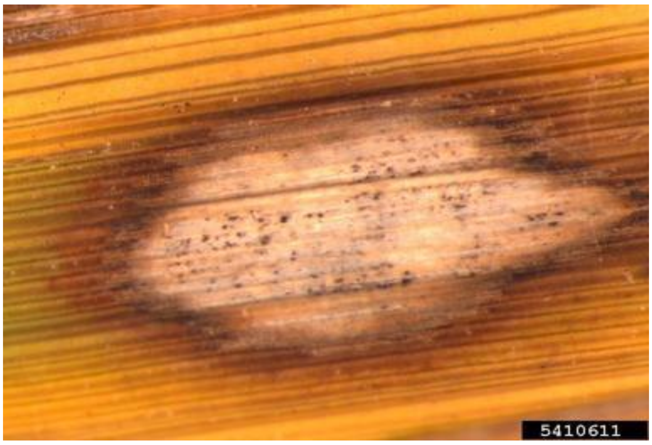

Figure 5: Photo by Donald Groth, Louisiana State University AgCenter, Bugwood.org

Figure 6: Photo by Donald Groth, Louisiana State University AgCenter, Bugwood.org

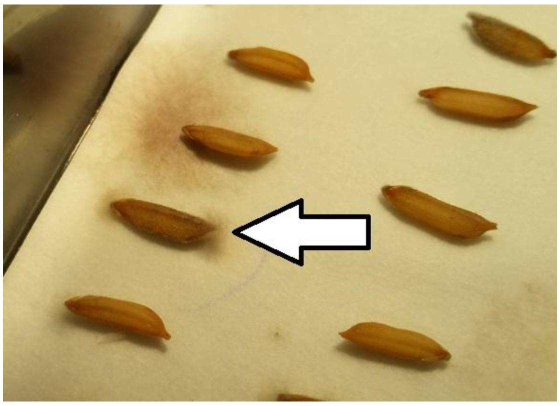

Figure 7: Fungal mycelia (left arrow, amplified on the right (Source: http://www.agronomicabr.com.br/files/1-alternaria-2a.jpg)

Figure 8: *T. padwickii* invades the kernel, developing brown-black spots or blotches. Shrivelled, discoloured and brittle grain results from such infection (CPC 2016)

5. Means of movement and dispersal

Seed is the main long-distance vector of the pathogen. The seed trade has facilitated the worldwide distribution of the disease. Locally, transfer of contaminated equipment may allow transmission of the disease from one glasshouse, field or farm to another. Conidia of *T. padwickii* are airborne and most abundant at the time of heading and grain ripening (Sreeramulu and Vittal, 1966; Groth 1992). Large numbers of conidia may become airborne during the harvest (Atluri and Murthy, 2002). Sclerotia and mycelium could be carried in plant debris (Ellis and Hollidat, 1972) with or without soil. Because the fungus is one of many infecting rice seed, often at high levels (Mathur et al., 1972), it is likely to have been introduced to new areas of rice cultivation in untreated imported seed.

6. Impact

T. padwickii is widespread in many major rice-growing regions throughout the world. Grain discolouration caused by this pathogen alone or in combination with other fungi can reduce market value (Saini, 1985; Lee et al., 1986). Leaf spots usually do not cause much damage. High levels of seed infection and associated seed rotting can have a serious impact on stand establishment in nursery beds and in the field, but the importance of the disease is "commonly underestimated" (Ou, 1985). In the USA, Kulik (1977) found a low correlation between seed infection by T. padwickii and reduction of seed germination . Very high levels of seed infection (39-80%) have been recorded (Vir et al., 1971; Mathur et al., 1972; Ou, 1985). Infection rates of 28.9% were detected in a seed lots in Iran (Zad and Khosravi, 2000). Up to 25% of seeds harvested from naturally infected paddy cv. Pusa 33 exhibited the disease in Karnal, India, in 1996 (Dharam Singh et al., 2001).

7. Movement in trade

T. padwickii is commonly seed-borne and is carried at high levels; it is therefore likely to be introduced on imported seed unless efforts are made to exclude it. Trade in infected leaves, seedlings and plants are rare (CABI, 2016). Transport to and transmission in new areas may be prevented by use of tested clean seed (USDA, 2010)

8. Phytosanitary significance

T. padwickii is a quarantine pest in Kenya .The testing and certification of rice seed is necessary to prevent the importation of this seedborne pathogen into new areas or the increase of inoculum in already infested areas. *T. Padwickii* The fungus has been detected in seed of exotic germplasm imported to India (Agarwal et al., 2006) as well as in inert matter contaminating local seed lots in Bangladesh (Khokon et al., 2005). In New Zealand, *T. padwickii* was detected only in seed lots of foreign origin, not in the native ones (Lau and Sheridan, 1975).

9. Management

Cultural control and sanitary measures

- Destruction of rice stubble and straw by burning is recommended (Padwick ,1950) .
- A row spacing trial (15, 20, and 25 cm wide) showed that seedborne infections were highest with the closest spacing. Use wider spacings within the row to avoid incidences of seed borne infections brought by close spacings..
- Seed infection also increased proportionally as nitrogenous fertilizer applications were increased from 0 to 200 kg/ha.Do not make uneccesary applications of nitrogenous fertilizers as increased applications of nitrogenous fertilizers increases incidences of seed infection. (Agarwal et al., 1975).

Physical/mechanical control

- The hot water treatment of seed is an alternative to cleaning and use of chemicals but may reduce the level of germination. Tisdale (1922) found that, after a presoaking period of 16 hours in tepid water, soaking seed for 15 min in water at 54°C gave the best results for germination and disinfection.

Biological control

- A formulation of rice rhizosphere-inhabiting bacteria Pseudomonas fluorescens in powdered talc at the rate of 5 and 10 g per kg (Praveen Kumar et al., 2001) was effective in reducing seedling infection by A. the rates of.
- The essential oils of Ocimum gratissimum (African basil) and Thymus vulgaris (thyme) had an effect similar to that of mancozeb in reducing transmission of fungi from seeds to seedlings Nguefack et al. (2008).
- A natural chemical, 2-hydroxy-4-methoxybenzaldehyde, isolated from the Indian plant Decalepis hamiltonii was almost as effective as thiram as a treatment against *T. padwickii* and other seed-borne fungi (Devihalli Chikkaiah et al., 2009).

Chemical control

- fungicide sprays to control of grain discoloration, including: chlorothalonil, mancozeb, carboxin, and fenapanil (Ferrer et al., 1980); polyoxin (Arunyanart et al., 1981); edifenphos, iprobenfos and benomyl (Rajan and Nair, 1979); and iprodione (Rodriguez et al., 1988).
- Several seed-treatment fungicides are reported as giving control of seed infection, including edifenphos, iprobenfos, and benomyl (Rajan and Nair, 1979); N-ethylmercurio-4-toluenesulfonanilide (Aleshin et al., 1980); and mancozeb (Vir et al., 1971).
- Chemicals from natural sources may provide control that is less toxic to mammals and less polluting in the environment Shanmugam (2004). The essential oils from the leaves and rhizomes of Curcuma longa (turmeric) are also effective against the fungus, but at higher concentrations (Behura et al., 2000).

Host resistance

Some breeding lines were found resistant in nursery tests in Java, Indonesia (Soepriaman et al., 1976).This shows that the disease can be controlled through resistant varieties.

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