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Microdochium oryzae Associated with Rice Leaf Scald Disease in Paraguay

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Abstract

Rice leaf scald is characterized through the presence of different symptoms, according to the rice crop stages such as necrotic lesions in leaves and leaf sheaths and staining of glumes of rice grains. The symptom that manifests on the leaf blades is the most common and easy to recognize in field conditions. The fungus is also observed as associated with rice grains integrating the causal complex of spotting rice husks. Infected seeds and crop remains are the main source of inoculum of the disease. The disease is caused by *Microdochium oryzae* (Hashioka & Yokogi) Samuels & I.C. Hallet (anamorph) while in sexual state (teleomorph), it is caused by *Monographella albescens* (Thüm.) W.O. Parkinson, Sivan. & C. Booth. This research work was carried out at the Phytopathology Laboratory of the Faculty of Agricultural Sciences of the National University of Itapúa, Paraguay during the year 2016. The main aim is to identify the morphology of fungus associated with rice scald in Paraguay. Diseased leaf samples, with typical symptoms of rice leaf scald, were collected at reproductive stage of two rice cultivars i.e., IRGA 424 and IRGA 428, the most sown cultivars in the country, from six districts in the departments of Itapúa and Misiones. Visual macroscopic observations were made for the description of symptoms present in the affected leaves to compare with the findings of other authors. A part of the collected material was isolated and grown using filter paper method in Potato Dextrose Agar culture at favorable conditions such as 25-30°C, 12/12 hours of light and darkness for 8-10 days. The fungus colonies and size measurement of the conidia were described. The field symptoms of rice leaf scald were observed in mature leaves which included typical zoned lesions that start at the edges or tips or the leaves with oblong form with light brown halos. When the leaves mature, the lesions become enlarged and finally fuse. Colony of the fungus on culture media grows moderately fast showing white aerial mycelia or white cream-to-pink mycelia of the fungus. Conidia are moon-shaped, simple cells, occasionally two cells, thin walls and hyaline at microscopy sized between 8-13 µm long by 3-5.5 µm wide. Morphometric characteristics of the fungus identified in this study correspond to *Microdochium oryzae* which is associated with symptoms of rice leaf scald.

Keywords: *Oryza sativa*, pathogens, rice leaf scald, *Microdochium oryzae*, *Monographella albescens*

INTRODUCTION

Rice (*Oryza sativa*) is cultivated mainly in the departments of Misiones, Itapúa and Caazapá and to a lesser extent in Paraguari , with a total area coverage of 160,000 hectares for the year 2016-17. (MAG, 2016). Rice crop can be affected by a number of fungal diseases in all rice producing countries in the world. The rice leaf scald has a wide global distribution and it is present in several countries of American, African and Asian continents, both in crops under irrigation or in dry land, causing considerable losses (Filippi&Prabhu, 2005; Ou, 1985; Webster & Gunnell, 1982). In Paraguay, the first official information was published between 2015 and 2017 regarding the prevalence of fungi causing leaf spots, stem and panicle that affect the rice crop production in different regions of the country (Quintana *et al*,. 2015 a; 2016 b; 2017c). With regards to the management of such diseases, the official recommendations propose to control the fungal diseases using fungicides at flowering stage and later a second application, but without characterizing the prevalence of diseases present in the field individually which is required in order to avoid the indiscriminate use of fungicides. In spite of the global prevalence of the rice leaf scald pathogen, the research about it, is still scarce in South America. So, in 2016, the current study was started to perform rice field monitoring during reproductive crop stage in main rice producing districts of the country.

Field symptoms of rice leaf scald were observed in mature leaves which includes typical zoned lesions that start at the edges or tips or the leaves in oblong form with light brown halos. When the leaves mature, the lesions become enlarged and finally fuse. The disease can be a serious problem under favorable climatic conditions since it accelerates the development of pathogen (Turner and Black 2001). Hernandez *et al*., (2016) stated that rice scald has the potential to significantly reduce the rice yields through the destruction of leaf surface area and seed decay. Filippi and Prabhu (2005), in their study conducted in Brazil,indicated that when the disease manifests itself at the beginning of booting stage, it produces leaf death and therefore paralyzes the growth of the plants, affecting the quantity and quality of the grains. The disease is caused by *Monographella albescens* (Thümen) Parkinson, Sivanesan & C.Booth in its sexual state (teleomorph) and by *Microdochium oryzae* in its asexual state (anamorph) (Hashioka & Yokogi) Samuels & I.C.Hallet (Ou, 1985; Webster & Gunnell, 1992; Mew & Gonzalez, 2002).

The objective of this work is to identify the morphology of the fungus associated with the rice leaf scald in Paraguay.

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MATERIALS AND METHODS

Sample collection:

Rice field monitoring of two commercial varieties such as IRGA 424 and IRGA 428 was carried out in the main rice production areas of the country during 2015/2016 cycle. 50 leaf samples with symptoms of concentric bands that started at the tip of the leaf with an incidence of 30-40% on each cultivar were collected at panicles' formation stage. The samples were collected in the districts of Gral. Artigas, Coronel Bogado and Salitre Cué (Department of Itapúa), and Santa María, San Juan Bautista and San Juan de Ñeembucú (Department of Misiones).

Isolation and purification:

The affected tissues of the leaves were cut into small pieces, placed in petri dishes and incubated at 25-30ºC, 12/12 hours of light and darkness (ISTA 2003) for 8-10 days. The samples were then examined under a stereoscopic microscope and the spores of the fungus were subsequently isolated and cultured in Potato Dextrose Agar (PDA) with (81.5%, pH 6) to obtain pure culture. The culture was incubated for 8-10 days.

Identification of the fungus:

The pathogen was identified using a stereoscopic microscope and optical. The sample was considered to be infected with fructification structures of the pathogen (sporodoquium).The morphology and the development of fungi colonies were observed and described. Morphometric characteristics of spores were noted down to compare with, what was proposed by Ou (1985) and Mew & González (2002).

RESULTS AND DISCUSSION

Ou, (1985) and Webster & Gunnell (1992) described the symptoms of leaf rice scald as concentric bands with alternating light brown to dark brown shades that begins at the end or edges of the leaf blades. Subsequently, the lesions coalesce, causing necrosis and death of the foliar area. Similar symptoms were observed in the current study leave samples too. Mew and Gonzales (2002) stated that the colony of *Microdochium oryzae* grows moderately fast in Potato Dextrose Agar medium, showing white aerial mycelia or white cream to pink mycelium (fig.1). With regards to the methods used to detect fungus, the filter paper and agar are mentioned by Boratynski, (1979); Mew & Misra, (1994) as the most sensitive for the analyses of seed health testing.

Conidia are moon-shaped, simple cells, occasionally two cells, with thin walls and hyaline when viewed using microscope and sized between 8-13µmlong and 3-5.5µmwide (fig. 2). Morphometric characteristics of the fungus identified in this study are similar to those reported by several authors (Ou, 1985; Mew & Gonzales 2002; Tunner and Black 2001) and correspond to *Microdochium oryzae* (Hashioka and Yokogi) Samuels & Hallett, in its asexual state (anamorph).

Gutierrez *et al*., (2007) detected the presence of the sexual stage of the fungus, *Monographella albescens*, during the crop cycle 2004/2005 and 2005/2006 in Corrientes, province of Argentina. Gutierrez *et al*., (2009) mentioned that the fungus is associated with rice grains integrating the causal complex of spotting rice husks at Northern Argentina.

In Paraguay, the rice leaf scald has not been studied in depth, despite observation of the symptoms on rice fields. The fungus *Microdochium oryzae* is yet to be characterized as a causal agent of rice scald. This is the first report of the occurrence of rice leaf scald in Paraguay.

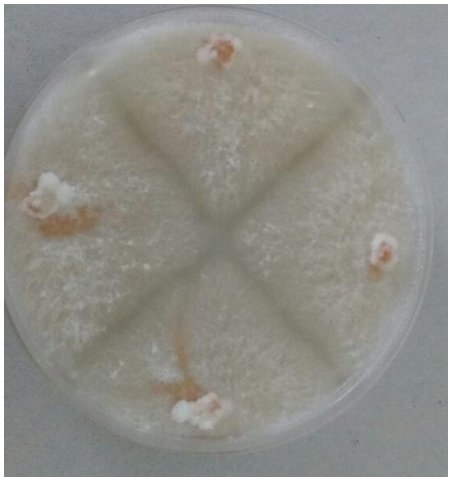

Fig. 1:Fungus sporulation on PDA medium.

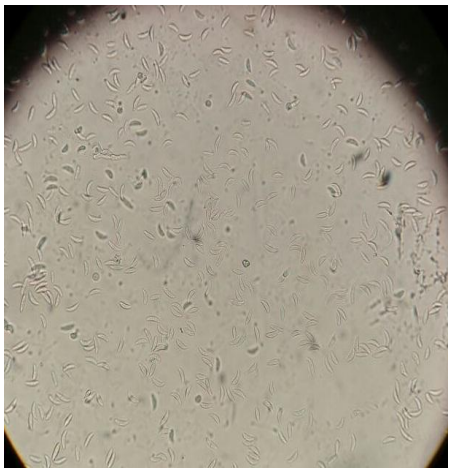

Fig.2:Conidia of *M. oryzae* (40 x).

Conclusions:

The symptomatology of scald observed in rice leaf samples collected in the departments of Itapúa and Misiones were similar to the ones reported in global bibliography. The morphology of the fungus mycelium grown in Potato Dextrose Agar medium appears as white aerial mycelia and white cream-to-pink colony.

The conidia are moon-shaped, simple cells, occasionally two cells with thin walls and hyaline at microscopy sized between 8-13 µm long by 3-5.5 µm wide.

These morphometric characteristics of the fungus correspond to *Microdochium oryzae* (Hashioka & Yokogi) (Samuels & I.C.Hallet) in its asexual state (anamorph). The mentioned fungus is in association with rice leaf scald in Paraguay.

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