Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Stem Rust, Caused by *Puccinia graminis*, and Crown Rust, Caused by *Puccinia coronata* var. *avenae* f. sp. *avenae*, on Tall Fescue (*Festuca arundinacea*) in Georgia, U.S.A.

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Stem rust, caused by *Puccinia graminis*, and crown rust, caused by *P. coronata*, are common rust diseases on cool-season grasses (Karakkat et al. 2018), for which long-distance spore dispersal was recorded in northern United States (Harder and Haber 1992). During the summers of 2019 and 2020, severe infection of stem rust and crown rust was observed on >60% of tall fescue (*Festuca arundinacea*) germplasm plants in a breeding nursery located at the University of Georgia, Griffin, GA. Rust-infected leaves first presented uredinia pustules and then black telia toward the end of the season. The uredinia pustules of stem rust were brick-red and those of crown rust were yellow and arranged along the host veins. The urediniospores were one-celled, round to ovoid, and measured $20.75 \pm 2.44 \mu\text{m}$ (crown rust) to $27 \pm 3.60 \mu\text{m}$ long (stem rust). The teliospores were two-celled and measured from $45.75 \pm 10.14 \mu\text{m}$ (stem rust) to $51.60 \pm 4.0 \mu\text{m}$ long (crown rust) (Cummins 1971; Leonard and Szabo 2005). Urediniospores of both rusts were collected from infected plants in the field in April of 2020 using a Piston vacuum pump (Welch by Gardner Denver) and stored at -80°C in 1.5 ml Eppendorf tubes. Genomic DNA was extracted by grinding the urediniospores in liquid nitrogen using mortar and pestle, followed by the cetyltrimethylammonium bromide method (Doyle and Doyle 1987). The internal transcribed spacer (ITS) region of the ribosomal DNA was amplified using the ITS5-ITS4 primers (White et al. 1990). BLASTn and phylogenetic analyses revealed that the sequence of stem rust (GenBank no. MW430963) and

crown rust (GenBank no. MW431324) pathogens had >99% similarity with *P. graminis* (GenBank no. HQ317538) and *P. coronata* var. *avenae* f. sp. *avenae* (clade V; Liu and Hambleton 2013) (GenBank no. EU014044), respectively. Pathogenicity tests were conducted on the tall fescue cultivar 'Bandit'. For each rust, 12 pots (10 × 10 cm) were planted, each containing 13 seeds in a Sungro professional growing mix soil (Sun Gro Horticulture Distribution). The plant materials were kept in the greenhouse at $20^\circ\text{C}/25^\circ\text{C}$ (night/day), 15 h of light, and watered twice a week for 4 weeks. Urediniospores were recovered from -80°C and allowed to acclimate at room temperature for 1 h. For each rust, 20 ml of suspension containing 1×10^5 urediniospores/ml and 5 μl of Tween 20 (Agdia, Elkhart, IN) was used to inoculate six pots, and six control pots were sprayed with sterile water. After inoculation, plants were allowed to dry for 1 h and then transferred to a dark chamber at 20°C and 90% humidity for 12 to 15 h. At 10 days postinoculation, all inoculated plants developed rust symptoms identical to those observed in the field, whereas control plants had no symptoms. Stem and crown rust pathogens were reisolated from the artificially inoculated tall fescue plants. Based on form, size, color, and number of cells forming the spores, a 1947 *Festuca elatior* specimen from Georgia mentioning *P. coronata* (Hanlin 1966), held at the Julian H. Miller Mycological Herbarium (catalog no. GAM00013162), was discarded as an earlier record of *P. coronata* var. *avenae* and could have been misdiagnosed. Due to the fragile integrity of the original infected plant sample as well as the incipient infection, DNA identification was unsuccessful. To our knowledge, this is the first morphological, genetic, and taxonomic report of *P. graminis* and *P. coronata* var. *avenae* f. sp. *avenae* on tall fescue in Georgia, U.S.A.

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