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First record of *Gibberella zeae* and *Gibberella coronicola* on millet in Western Australia

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Abstract Perithecia carrying asci with mature ascospores were observed on millet stubble (*Panicum miliaceum* and *Panicum sp.*) and were identified as *Gibberella zeae* and *Gibberella coronicola* for the first time in Western Australia. Morphological identification and molecular assays confirmed the presence of the anamorph *Fusarium graminearum* and *Fusarium pseudograminearum* respectively.

Keywords *Gibberella zeae* · *Gibberella coronicola* · *Panicum miliaceu*m · Fusarium head blight · Crown rot

Fusarium graminearum (Schwabe). and *F. pseudograminearum* (Aoki & O'Donnell), the causal agent of Fusarium head blight (FHB) and crown rot (CR) of cereals respectively, have been reported in Queensland, northern New South Wales, including the Liverpool Plains area, on wheat, barley, maize and sorghum (Manning et al. 2000). *F. pseudograminearum* has also been reported in Victoria and South Australia on wheat, and barley (Akinsanmi et al. 2004; Burgess et al. 1975, 2001; Purss 1969, 1971). *F. graminearum* was first detected in Western Australia (WA) in 1959 on sorghum causing a stalk rot (Shivas 1989); and more recently in 2004 on wheat and barley grain (Wright et al. 2010).

Gibberalla zeae (Schw.), the teleomorph of *F. graminearum* is known to occur abundantly in nature throughout the world (Summerell et al. 2001), causing stalk and cob rot of maize and FHB of cereals. The fungus is homothallic and readily produces fertile perithecia in culture. In contrast, *G. coronicola* (Aoki and O'Donnell 1999), the teleomorph of *F. pseudograminearum,* is less common (Summerell et al. 2001) and generally does not produce perithecia in culture. *G. coronicola* has been found on mature wheat crops when the soil is wet or after a rain period. In 1996 and 1999, Summerell et al. (2001) collected *G. coronicola* perithecia associated with high levels of crown rot in wheat crops from the Moree district of NSW. However, in WA neither of the teleomorph stages had been previously detected on cereal grain crops; although, *G. zeae* had previously been reported as causing foot and root rot in rice (*Oryza sativa* L.), in Kununurra, WA (Shivas 1989).

With the identification of *F. graminearum* on wheat seeds for the first time in WA in June 2004 (Wright et al. 2010), a field survey was conducted to investigate if the anamorph and teleomorph stages survive in paddocks growing summer small grain cereal crops. The survey was conducted by Department of Agriculture and Food, Western Australia (DAFWA) plant pathologists and local District Office staff. Stubble samples were collected in July and August from locations with a history of summer production of millet for grain or forage production; 33 millet paddocks were inspected and samples collected from Mt Barker to Condingup (Fig. 1).

The stubble collected was examined visually for the presence or absence of perithecia. The size of the perithecia and associated ascospores were measured. Single ascospore cultures were then grown on carnation leaf agar (CLA) and on potato dextrose agar (PDA) for 4 weeks as per protocol

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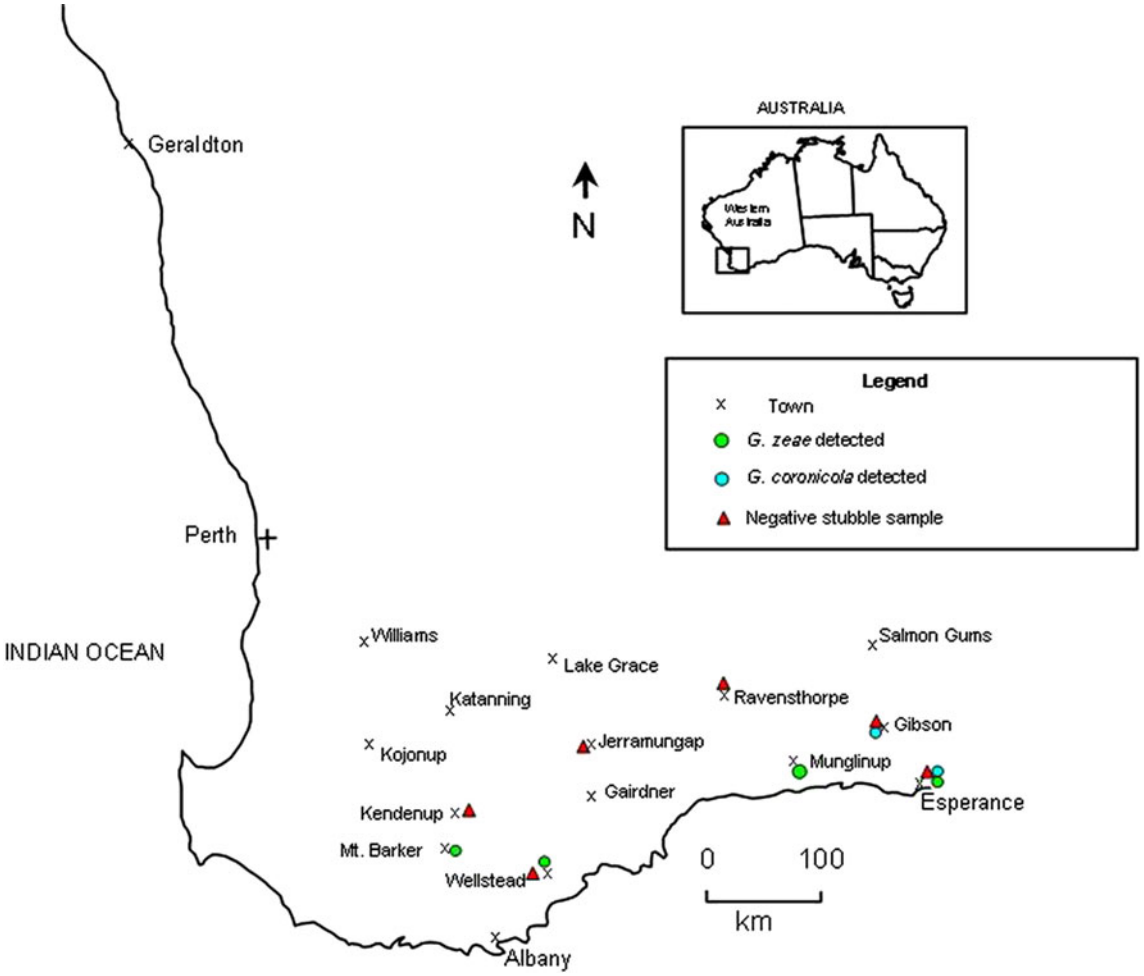

Fig. 1 Map of survey area showing detection of *G. zeae* and *G. coronicola* on millet stubble in Western Australia

in Burgess et al. (1994). The anamorph stage of the fungus was then identified morphologically, according to Burgess et al. (1994) and assayed by polymerase chain reaction (PCR) using species-specific primers to verify results. The primer sets used were: (a) Fg 16NF and Fg 16 NR for *F. graminearum* (Nicholson et al. 1998); and (b) FPG-F, FPG-

Table 1 Morphological characteristics of perithecia, asci and ascospores of *Gibberella zeae* and *G. coronicola* collected from millet stubble (*Panicum sp.*, and *P.miliaceum*) occurring naturally in the field

WA Culture Collection Number (WAC)	Location	Host	Size of perithecia (Average of 10) µm	Colour and Shape of perithecia	Size of Asci (Average of >5) µm	Size of Ascospores (Average of 10) µm	Teleomorph stage detected	Morphological results of anamorph stage	PCR results
11426	Gibson	*Panicum sp.*	262.5	Globose, dark	82×10	30.7×5.1	*G. coronicola*	*F. pseudograminearum*	*F. pseudograminearum*
11428	Gibson	*Panicum sp.*	205.0	Globose, dark	88×12	26.9×5	*G. coronicola*	*F. pseudograminearum*	*F. pseudograminearum*
11431	Esperance	*Panicum sp.*	316.2	Black/Purple Tuberculate	77×13	30.5×4.5	*G. coronicola*	*F. pseudograminearum*	*F. pseudograminearum*
11431	Esperance	*Panicum sp.*	316.2	Black/Purple Tuberculate	77×13	34.5×6.1	*G. zeae*	*F. pseudograminearum*	*F. graminearum*
11432	Mt Barker	*Panicum miliaceum*	286.9	Black/Purple Tuberculate	62.5×10	23.5×5.5	*G. zeae*	*F. graminearum*	*F. graminearum*
12340	Wellstead	*Panicum sp.*	212.0	Black/Purple Globose	93.5×10	22.5×5	*G. zeae*	*F. graminearum*	*F. graminearum*
12341	Munglinup	*Panicum miliaceum*	207.1	Black/Purple Tuberculate	76.6×9.6	25×5	*G. zeae*	*F. graminearum*	*F. graminearum*

WA Western Australia, *WAC* Western Australia Culture Collection Number

R (Williams et al. 2002) and Fp 1–1 and Fp 1–2 (Aoki and O'Donnell 1999) for *F. pseudograminearum*.

Based on the morphological characteristics of perithecia, asci and ascospores both *G. zeae* and G. *coronicola* were detected on 4 and 2 properties (Table 1) growing millet as a summer grain or forage crop in rotation with winter cereals respectively. The observed perithecia for *G. zeae* were black/purple in colour and globose/tuberculate in shape (Table 1). The average diameter of the perithecia was 212 μm. The ascospores were ellipsoidal, with an average of 3 septa and with no constriction. The size of the ascospores ranged from 22.5–34.5×5–6.1 μm, (averaging 26×5.4 μm) consistent with those observed by Summerell et al. (2001). For *G. coronicola* the observed perithecia were globose and dark and the ascospores were ellipsoidal, generally with 3 septa and a slight constriction at the septa. The size of the ascospores ranged from 22–30×4.4–5 μm, (averaging 26.5×4.6 μm) (Table 1) and were found to be consistent with the previously published description of this fungus (Summerell et al. 2001).

All single ascospore cultures of *G. coronicola* were identified as *F. pseudograminearum* by both morphological and PCR analysis. The PCR analysis on single ascospore cultures of *G. zeae* were confirmed as *F. graminearum*. Three out of four cultures were also confirmed morphologically to be *F. graminearum*. Because one of the cultures failed to produce perithecia it was identified as *F. pseudograminearum*. Samples of both the stubble and cultures have been submitted to the WA Culture Collection (WAC) (Table 1).

To our knowledge this is the first report of *G. zeae* and *G. coronicola* occurring on millet stubble in Western Australia. These findings have implications in the long distance spread of the pathogens *G. zeae* and *G. coronicola* associated with the disease Fusarium head blight and Fusarium crown rot in the wheatbelt, where millet is used as a summer rotation crop.

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