"Gibberella temperata (Fusarium temperatum) sp. nov. from maize in Belgium, an emergent species closely related to Fusarium subglutinans"

Scauflaire, Jonathan ; Gourgue, Mélanie ; Munaut, Françoise

ABSTRACT

A novel biological species of Fusarium, Fusarium temperatum Scauflaire et Munaut sp. nov. (and its teleomorph: Gibberella temperata Scauflaire et Munaut sp. nov.) was described within the Gibberella fujikuroi species complex (GFC), on basis of a robust polyphasic approach. The morphology, the sexual sage, the genetic diversity and its relationships with species within the GFC were analyzed.

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Scauflaire, Jonathan ; Gourgue, Mélanie ; Munaut, Françoise. Gibberella temperata (Fusarium temperatum) sp. nov. from maize in Belgium, an emergent species closely related to Fusarium subglutinans. Fusarium Satellite Meeting (Amsterdam, The Netherlands, du 28/03/2010 au 29/03/2010). http://hdl.handle.net/2078.1/135006
**Abstract**

A novel biological species of *Fusarium*, *Fusarium temperatum* Scauflaire et Munaut sp. nov. (and its teleomorph: *Gibberella temperata* Scauflaire et Munaut sp. nov.) was described within the *Gibberella* fujikuroi species complex (GFC), on basis of a robust polyphasic approach. The morphology, the sexual stage, the genetic diversity and its relationships with species within the GFC were analyzed.

**Materials and methods**

35 *Fusarium* sp. strains isolated from maize in Belgium were compared with *F. subglutinans* strains from the same origin, with the *Fusarium* sp. NRRL 26622 strain, and with other *Fusarium* species of the GFC. Therefore, we used a polyphasic approach based on:

- Morphological species recognition (MSR)
- AFLP study to compare the genetic similarity between the *Fusarium* strains
- Phylogenetic species recognition, using parsimony and Bayesian analyses (PPR)
- Biological species recognition using sexual crosses (BSR)

The AFLP analysis clustered the *F. temperatum* isolates and the *F. subglutinans* in two sister groups, with a 1% Dice similarity coefficient. This percentage is comparable to those observed between different mating populations in the GFC (Zeller et al., 2003). The genetic similarity between any *F. temperatum* pairs ranges from 74 to 100%, which is consistent with previous descriptions of isolates belonging to the same species within the GFC (Leslie and Summerell, 2006). Both tester strains of *F. circinatum*, *F. konzum*, *F. sacchari*, and *F. verticillioides* are included in the 4 other groups. The distinctness of all 6 groups was supported by bootstrap values of 78–100% in 1000 replicates (Fig. 13).

**Conclusion and Perspectives**

According to the interspecies and intraspecies mating compatibility testing of the present study, *G. temperata* represents a new biological species in the GFC, within the *‘American Clade’*. The relatively high percentage of female fertile strains and the observed mating type ratio (*MAT*-1:*MAT*-2 = 17:13) suggested that sexual reproduction may be common in *G. temperata* (Leslie and Kain, 1996).

**Gibberella temperata** (*Fusarium temperatum*) sp. nov. from maize in Belgium, an emergent species closely related to *Fusarium subglutinans*.

**Introduction**

Among the 3660 *Fusarium* strains belonging to 24 species isolated from maize during a 3-year survey in Belgium, 276 strains of an unknown species were collected (5%). Their elution factor (BF-1×) sequence showed 99% to 100% similarity to the sequence of *Fusarium* sp. NRRL 26622 strain (μMUG, 51714), which has been recently characterized phylogenetically distinct from *F. subglutinans* (O'Donnell et al., 2000), although it was reported to be sexually compatible with one of the *F. subglutinans* mating type tester strains (Scauflaire et al., 1995). The aim of the present paper was to study several traits of those *Fusarium* strains in order to define their taxonomical rank within the GFC.

**Phylogeny**

The combined (jstree and BF-1×) dataset consisted of 1184 aligned nucleotides. Bayesian analyses resulted in a posterior probability distribution containing 2000 samples per analysis. A total 1527 samples were discarded, and a majority rule consensus tree of the remaining combined samples was produced. Equally weighted parsimony analysis of the 207 parsimony informative characters resulted in 19 mostly-parsimonious trees of 145 steps. The Chi and Ti for the trees generated were 0.681 and 3.256, respectively. The majority rule consensus of those trees produced a tree of similar topology to that of the Bayesian analyses.

In all trees, in the major rule consensus tree, all strains of *F. temperatum* formed a strongly supported monophyletic group (Bayesian posterior probability (PP) = 1, bootstrapping (B) = 100). The *F. subglutinans* strains were placed in a distinct well-supported clade (PP = 1; B = 100) (Fig. 14). The overall tree topology was similar to those previously presented for the GFC (O'Donnell et al., 1998a), in which the strain NRRL 26622 (described here as a new biological species) was placed in the “American Clade”.

**Interspecies and intraspecies compatibility**

After determining the mating-type idiomorph for each *F. temperatum* strain using PCR assays, 5 *MAT*-1 and 5 *MAT*-2 strains were selected for fertility crosses.

- All 10 strains of *F. temperatum* were unaffected when crossed with the *F. subglutinans*, *F. oxysporum*, and *F. konzum* tester strains belonging to the “American Clade”, except in one replicate where MUCL 52465 produced one single fertile perithecium with the *F. subglutinans* tester strain. Although such a particularity was not a significant result in the crossing tests, similar examples of interfertility between different biological species of the GFC were already described (Scauflaire et al., 2004).

- The 5 *MAT*-1 strains, the 5 *MAT*-2 strains and strain NRRL 26622 (*MAT*-2) were intermated in all possible compatible pairs. All 11 strains of *F. temperatum* were fertile as male in these crosses and 6 strains were female fertile. Based on those intra-specific crosses, MUCL 52463 and MUCL 52436 were selected as reliable female fertile tester strains of *MAT*-1 and *MAT*-2, respectively.

According to the interspecies and intraspecies mating compatibility testing of the present study, *G. temperata* represents a new biological species in the GFC, within the “American clade”. The relatively high percentage of female fertile strains and the observed mating type ratio (*MAT*-1:*MAT*-2 = 17:13) suggested that sexual reproduction may be common in *G. temperata* (Leslie and Kain, 1996).

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**Interactions and perspectives**

- Based on the results of this polyphasic approach, the population of *Fusarium* strains isolated from maize in Belgium and the phylogenetic species *Fusarium* sp. NRRL 26622 have been raised to a new biological species rank *Fusarium temperatum* Scauflaire et Munaut sp. nov. (teleomorph: *Gibberella temperata* Scauflaire et Munaut sp. nov.).
- The *F. temperatum* sp. subglutinans ratio was very high in Belgium fields (27/6), suggesting that *F. temperatum* apparently completely *F. subglutinans*.
- Preliminary pathogenicity assay results confirm the ability of *F. temperatum* to cause seed rot and seedling blight with a similarity towards *F. subglutinans* (Scauflaire et al., unpublished).
- An interesting hypothesis for the separation of these two species may be based on climate (Moretti et al., 2008), *F. temperatum* strains being more common in warmer and dryer regions.
- Finally, given that a culture extract of strain NRRL 26622 was reported to be toxicogenic (Severson et al., 1999), studies are also in progress to elucidate the mycotoxin potential of *F. temperatum*.

**Acknowledgments**

We thank the CIPF and the CARAH for the field experiments.

**References**


**Author contributions:** Jonathan Scauflaire and Melanie Gourgue contributed equally to this work.