

Pyricularia oryzae causing blast on foxtail millet in Iran

Adel Pordel, Department of Plant Protection, Faculty of Agricultural Sciences & Engineering, University of Tehran, Karaj 31587-77871, Iran; **Didier Tharreau**, CIRAD, UMR BGPI, F-34398 Montpellier, France. BGPI, Univ Montpellier, CIRAD, INRA, Montpellier SupAgro, Montpellier, France; **Sandrine Cros-Arteil**, BGPI, INRA, Univ Montpellier, CIRAD, Montpellier SupAgro, F-34398 Montpellier, France; **Esmail Shams**, Department of Plant Protection, Faculty of Agricultural Sciences & Engineering, University of Tehran, Karaj 31587-77871, Iran; **Ali Moumeni**, Rice Research Institute of Iran, Mazandaran Branch, Agricultural Research, Education and Extension Organization, Postal-Code 46191-91951, Km8 Babol Rd., Amol, Mazandaran, Iran; **Amir Mirzadi Gohari** and **Mohammad Javan-Nikkhah**, Department of Plant Protection, Faculty of Agricultural Sciences & Engineering, University of Tehran, Karaj 31587-77871, Iran.

*Corresponding authors email: jnikkhah@ut.ac.ir.

Each year *Pyricularia oryzae* causes blast diseases of rice, wheat, and cereals of local importance (millets) which destroy enough food supply to sustain millions of people (Pennisi 2010). Blast disease is one of the major constraints for the production of foxtail millet (*Setaria italica*) especially in northern China and India (Nakayama et al. 2005). Blast in its severe form causes up to 30 - 40 percent loss in grain yield in these areas (Nagaraja et al. 2007). In July 2016, during the survey of infected foxtail millet farms in Mazandaran province of Iran, some plants of foxtail millet showing typical blast symptoms were collected. All the leaves and heads of plants in the fields were infected and disease was widespread on all plants in several fields. Brown spots on heads and lesions on leaves appeared as diamond shape with a light margin (Fig. 1 A-B). Five isolates of *Pyricularia* sp. were obtained from disease samples as described by Pordel et al. (2015). To determine the species of *Pyricularia* causing blast on foxtail millet, we sequenced four gene regions (*ACT/CAL/ITS/RPBI*) used for taxonomic identification of *Pyricularia* species (Klaubauf et al. 2014). Sequences were generated for two of the five Iranian strains (IR0106 and IR0107) collected on foxtail millet and were aligned with 15 additional sequences of *Pyricularia oryzae* strains from different hosts, and from the closely related species *P. pennisetigena*, *P. penniseticola*, *P. ctenantheicola*, and *P. grisea* reported in the reference publication of Klaubauf et al. (2014). The two strains were clearly assigned to *P. oryzae* (Fig. 2). Foxtail millet plants were inoculated with the strains isolated from diseased samples following a protocol adapted from Silue et al. (1992). Typical diamond-shaped, dark-bordered lesions with pale centers were

visible on leaves of all inoculated plants after five days and were similar to lesions observed in the field (Fig. 1C). Foxtail millet strains caused severe lesions leading to complete leaf wilt (Fig. 1D). The fungus was re-isolated from leaf lesions of inoculated plants and morphologically identified, confirming Koch's postulates. This disease should be monitored because it may be an emerging problem on foxtail millet crop in Iran where the area cultivated doubled in five years to reach 8 500 ha in 2016 (FAO 2018). This is the first report of blast disease outbreak on foxtail millet in Iran.

References

- FAO (Food and Agriculture Organization of the United Nations). FAOSTAT. 2018. <http://www.fao.org/faostat/en/#home> (consulted 26/02/2018)
- Klaubauf, S., Tharreau, D., Fournier, E., Groenewald, J. Z., Crous, P. W., de Vries, R. P., and Lebrun, M. H. 2014. Resolving the polyphyletic nature of *Pyricularia* (Pyriculariaceae). *Stud. Mycol.* 79: 85–120.
- Nakayama, H., Nagamine, T., and Hayashi, N. 2005. Genetic variation of blast resistance in foxtail millet (*Setaria italica* (L.) P. Beauv.) and its geographic distribution. *Genet. Res. Crop Evol.* 52: 863–868.
- Pennisi, E. 2010. Armed and dangerous. *Science* 327: 804–805.
- Nagaraja, A., Kumar, J., Jain, A. K., Narasimhzdu, Y., Raghuchander, T., Kumar, B. and Gowda, B. H. 2007. Compendium of small millets diseases. Project Coordinator Cell, All India Coordinated Small Millets Improvement Project, UAS, GKVK Campus, Bengaluru. pp80.
- Pordel, A., Javan-Nikkhah, M., and Khodaparast, S. A. 2015. Revision of *Pyricularia oryzae* and occurrence of new hosts for the pathogen Iran. *Iran J. Plant Pathol.* 52: 67–83.
- Silue, D., Notteghem, J. L., and Tharreau, D. 1992. Evidence of a gene-for-gene relationship in the *Oryza sativa*-*Magnaporthe grisea* pathosystem. *Phytopathology* 82: 577–580.



Fig. 1. Blast symptoms on foxtail millet heads (A) and leaves (B) in natural epidemics in the field and on leaves after inoculation in controlled conditions (C and D).

337x169mm (96 x 96 DPI)

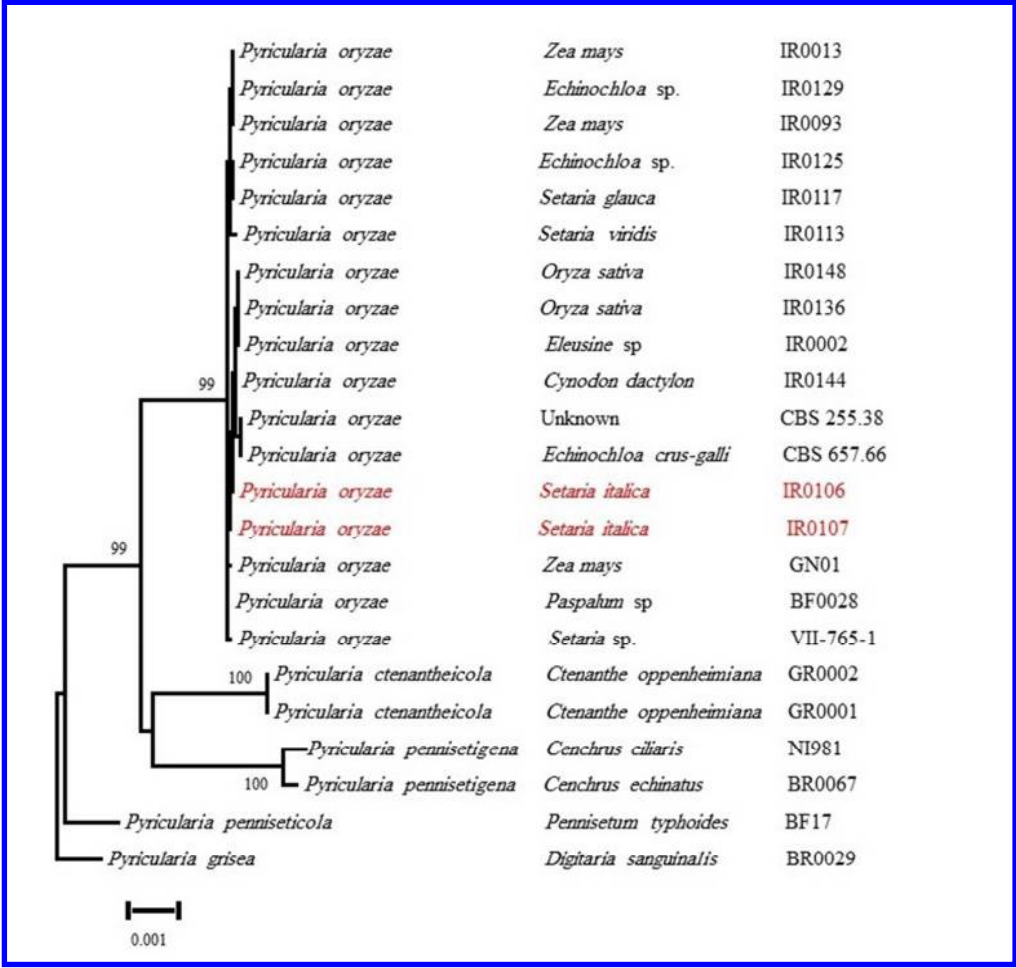


Fig. 2. Phylogeny of *Pyricularia* foxtail millet strains. Maximum likelihood (ML) tree inferred from combined ACT, CAL, ITS, and RPB1 sequences. Bootstrap support values from Maximum Likelihood analyses larger than $\geq 50\%$ are shown above internodes.

199x189mm (96 x 96 DPI)