

Virulence analysis of Polish isolates of the fungus *Zymoseptoria tritici* causing Septoria tritici blotch

Dominika Piaskowska*, Urszula Piechota, Magdalena Radecka-Janusik, Piotr Słowacki, Paweł Czembor

Plant Breeding and Acclimatization Institute – National Research Institute, Department of Applied Biology, Radzików, 05-870 Błonie

*d.piaskowska@ihar.edu.pl

INTRODUCTION

Septoria tritici blotch (STB) is one of the most significant leaf diseases of wheat and may cause up to 50% yield loss under favorable conditions. It is considered a high-risk pathogen due to its high potential for adaptation and substantial effective population size. It is estimated that over 70% of the fungicides applied annually to cereal crops in Europe target STB. This high selection pressure can be devastating, as STB has been reported to develop resistance to various classes of fungicides within a single growing season. Similarly, resistance in the host plant can also be overcome in a short period of time. Therefore, continuous monitoring of the pathogen population structure and its virulence against host resistance genes is crucial for developing resistant wheat varieties and promoting sustainable agricultural practices.

MATERIALS AND METHODS

The presented study used 33 single-pycnidial isolates of the fungus *Zymoseptoria tritici*, derived from leaves with STB symptoms, collected in various locations in Poland between 2021 and 2023 (Fig. 1). The virulence profile was determined based on the reaction of the differential set to infection with the fungal isolate. The differential set was composed of 23 wheat varieties/lines containing known STB resistance genes and 2 susceptible checks (Tab. 1). The experiments were conducted under controlled environment on seedlings. Tests were evaluated 21 days after inoculation. Plants were assessed in terms of the percentage of second leaf area covered with necrosis (%NEC) and pycnidia (%PYC). Precise determination of disease parameters was made using computer image analysis of infected leaves.

Table 1. Differential set comprising 23 wheat varieties/lines carrying known STB resistance genes and 2 susceptible checks.

VARIETY/LINE	Stb GENES AND QTL
1 Bulgaria88	Stb1 + Stb6
2 Veranopolis	Stb2 + Stb6
3 Israel493	Stb3 + Stb6
4 Tadinia	Stb4 + Stb6
5 Cs Synthetic (6x)7D	Stb5 + Stb6
6 Flame	Stb6
7 Estanzuela Federal	Stb7
8 M6 synthetic (W-7984)	Stb8 + QTL
9 Courtot	Stb9
10 Kavkaz-K4500	Stb10 + Stb12 + Stb6 + Stb7
11 TE9111	Stb11 + Stb6 + Stb7
12 Salamouni	Stb13 + Stb14
13 Arina	Stb15 + Stb6
14 M3 synthetic (W-7976)	Stb16q + Stb17
15 Liwilla	QTL
16 Mazurka	Stb7 + Stb12
17 Solitär	Stb6 + Stb11 + QTL
18 Apache	Stb11 + Stb4 + Stb5 + QTL
19 Balance	Stb18 + Stb6
20 Tuareg	QTL + Stb6
21 Florett	QTL + Stb6 + Stb15
22 Riband	QTL
23 Chinese Spring	Stb4 + Stb5 + QTL
24 Taichung29	susceptible check
25 Begra	susceptible check



Figure 1. Collection sites of *Z. tritici* isolates.

FINDINGS AND CONCLUSIONS

The tested *Z. tritici* isolates exhibited high diversity in terms of both disease parameters (Fig. 2, Fig. 3). The observed values of the %NEC parameter ranged from 0 to 100%, while the %PYC parameter ranged from 0 to 51%. The most virulent isolate, considering %NEC parameter, produced a necrotic leaf area of over 60% on 17 out of 25 tested lines, while the least virulent one caused necrosis of this severity on only one susceptible check. The occurrence of such a wide range of virulence variants in the set of tested isolates seems to indicate a high adaptive potential of the Polish population of *Z. tritici*. Among the varieties/lines of the differential set, the M3 Synthetic (W-7976) line (containing genes *Stb16q* and *Stb17*) exhibited the highest levels of resistance throughout the years, with a maximum %NEC value of 8% and no pycnidia formation observed for any of the tested isolates. Most of the tested isolates were virulent against varieties/lines containing genes *Stb1*, *Stb4*, *Stb5*, *Stb6*, *Stb7* and *Stb9*.

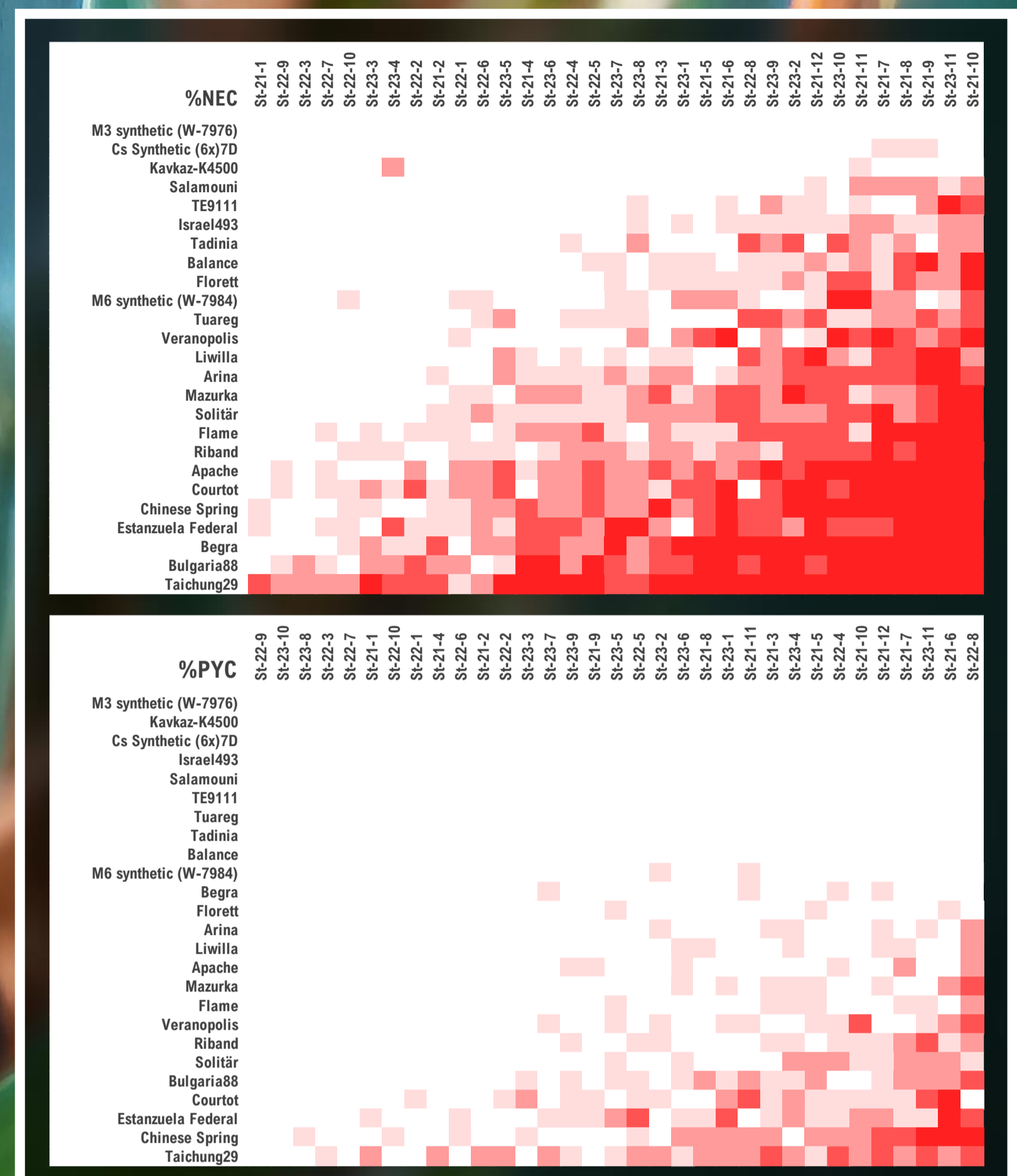


Figure 2. Mean percentage of leaf area covered with necrosis (%NEC) and mean percentage of leaf area covered with pycnidia (%PYC) among varieties/lines of the differential set for tested *Z. tritici* isolates. The isolates are arranged from least to most virulent. The tested wheat varieties/lines are arranged from most resistant to most susceptible.

Legend:

%NEC	0 – 23	23 – 41	41 – 60	60 – 78	78 – 100
%PYC	0 – 10	10 – 20	20 – 30	30 – 40	40 – 51

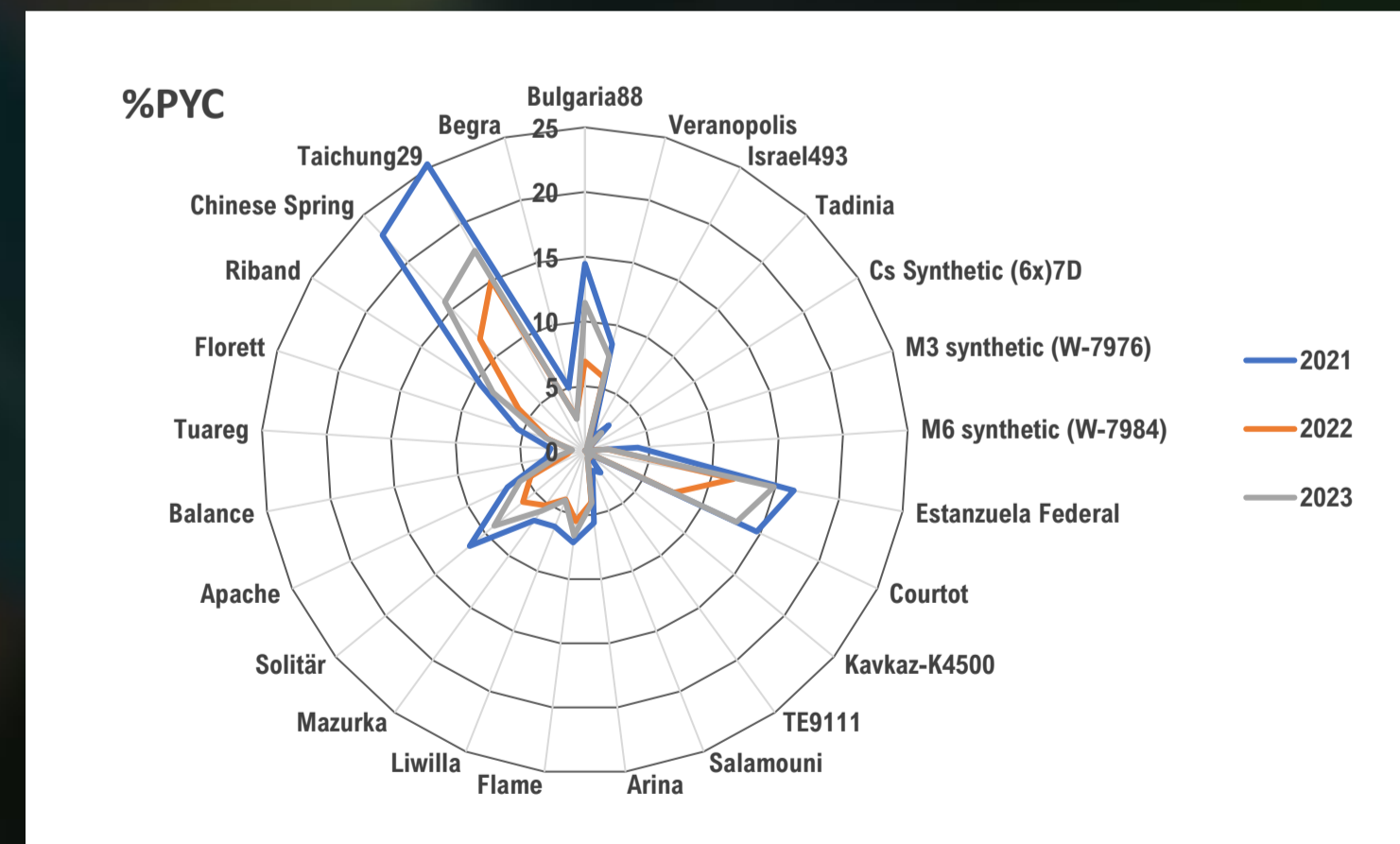
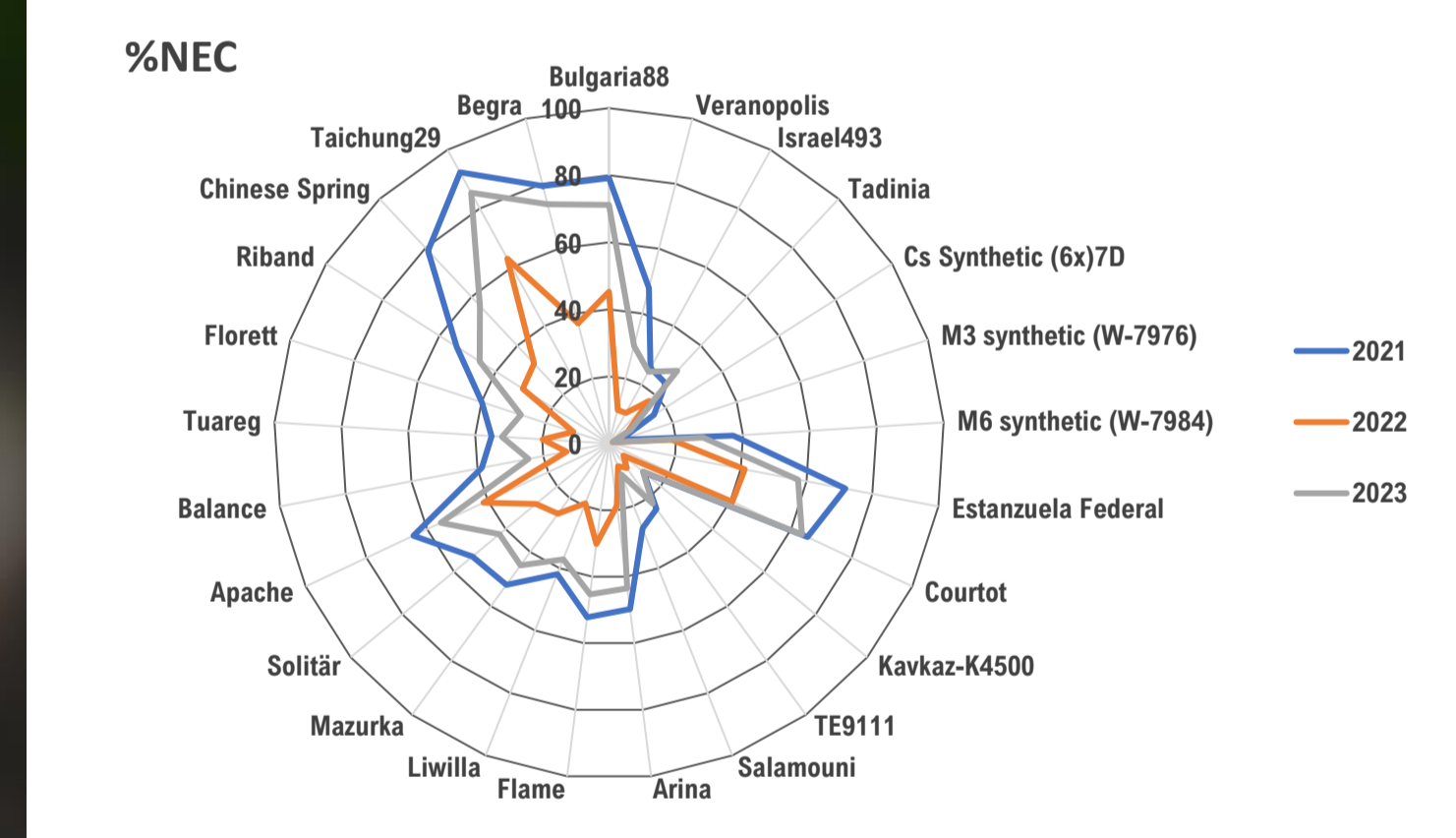


Figure 3. Mean percentage of leaf area covered by necrosis (%NEC) and mean percentage of leaf area covered by pycnidia (%PYC) among the varieties/lines of the differential set for all isolates collected in individual years.

ACKNOWLEDGEMENTS

This work was supported by the Polish Ministry of Agriculture and Rural Development, Program of Fundamental Research for Biological Progress in Crop Production (years 2021–2027): Task no. 2, entitled „Septoria tritici blotch of wheat (*Zymoseptoria tritici*): structure of the fungal population, identification of resistance loci in wheat and introduction of effective resistance genes into breeding materials”.