<u>Overview of virulence patterns of European common bunt races</u>

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Abstract

Based on a literature review, an overview of virulence patterns of European common bunt (Tilletia caries, T. laevis) races is given. In a separate field trial, the stability of virulence patterns over longer time spans was assessed at one location. The presented data suggests the need for the development of site-specific variety recommendations and appropriate measures to contain the spread of virulence.

Introduction and objectives

Common bunt in wheat is a dangerous disease in organic farming. A total failure of the harvest due to qualitative impairments is possible, and long-term problems can arise on farms as a result of contamination of machinery, equipment and possibly soil. Although common bunt can generally be effectively kept under control through comprehensive seed testing, the use of resistant varieties, etc., challenges remain. One reason is the race-specific effectiveness of the resistances. Regionally different races show complex distribution patterns due to seed-borne spore transmission. The genetic mechanism is determined by the gene-for-gene relationship: Each avirulence gene of the pathogen is associated with a resistance gene of the host. While the resistance genes for a selection of varieties are known (Borgen et al. 2023), there are gaps in our knowledge of the pathogens. The aim of this article is to provide an initial overview of the virulence patterns of European common bunt races. Practical recommendations for common bunt management are derived from this.

Methods

Data from trials in which the common bunt differential set (according to Goates 2012) was inoculated with races of European origins were collated in literature review. The data for the winter wheat lines with resistances Bt1-13 were used. In Bad Vilbel, a separate trial was set up in 2021 and 2022 (2 blocks, 1.5 m^2 plots, inoculum with 10,000 spores/grain) with the local common bunt race, which has been propagated since a trial in 2002/03 (see Table 1).

Results and discussion

Virulence patterns of European common bunt races for a selection of locations are shown in Table 1. Differences in the patterns can be detected both between countries (e.g. (a)virulence against Bt1 in AT or DE) and within countries (e.g. virulence against Bt8-10 occur in AT depending on the origin). No virulence against the (presumably oligogenic) resistances Bt11 and 12 was found at any of the sites. Currently available varieties are predominantly equipped with the resistances Bt5 and 7-10, which are effective at many, but not all locations according to Table 1. This makes it necessary 1) to develop site-specific recommendations for resistant varieties and 2) to contain the spread of these virulence through suitable measures. An initial proposal for such a set of measures is being developed in the EIP project ‘Seed Health Hesse’.

Table 1: Virulence (defined from an infestation level above the noted threshold, TH) of the common bunt races with the specified origin

Origin		TH	Virulence (marked grey) against BtX with X=													Source
Country	Location	[%]	1	2	3	4	5	6	7	8	9	10	11	12	13	
DE	Bad Vilbel	10	■	■					light grey							Wächter et al. 2007 (Trial in 2002/03, 2003/04) Charakterisierung der Resistenz von Winterweizensorten und -zuchtlinien gegenüber Steinbrand (*Tilletia tritici*) und Zwergsteinbrand (*T. controversa*) *
	Darzau		■	■					■							
	Münster			■					■							
	Salem			■					■		■					
	Seehausen		■	■	■				■						■	
AT	Gerhausen	10		■					■			■			■	Ritzer 2022 Comparing the pathogenicity of Austrian isolates of *Tilletia caries* on wheat (*Triticum aestivum*)
	Harmannsdorf			■	■				■						■	
	Hinzenbach			■	■				■						■	
	Loosdorf			■	■				■	■	■	■			■	
	Maissau			■	■				■			■			■	
	Sitzendorf			■	■				■	■					■	
	Thening			■					■		■	■			■	
PL	Winna Góra	<6		■	■		■		■						■	Kubiak und Weber 2008 Virulence frequency of *T.c.* and the…
CZ	Ruzyně?	10	■	■	■	■	■		■							Dumalasová 2021 Reaction of Czech registered varieties and…
HU	?	5	■	■	■	■			■							Veisz et al. 2000 Effect of common bunt on the frost resistance…
RO	Craiova?	10	■	■	■	■		■	■							Oncică et al. 2008 Identification of bunt resistance winter wheat…
LV	?	?	■	■	■				■			■			■	Matanguihan et al. 2011 Control of common bunt in organic wheat
CH	Zürich	5		■					■							Blažkova & Bartoš 2002 Virulence pattern of European bunt samples (*Tilletia tritici* and *T.laevis*) and sources of resistance
BG	Sadovo	5		■		■		■	■							
SE	?	5	■	■					■			■				

* At location Bad Vilbel: Extra trial in 2021/22, 2022/23 (in which no virulence against Bt7 was found, field marked light grey)

Care should be taken when interpreting these data, as illustrated by the example of Bt7 resistance. Although virulence against this resistance is present at all locations, many years of practical experience show that varieties with Bt7 usually remain infestation-free, at least in Germany. It should be noted that the absolute infestation level of the Bt7 lines in the trials from Table 1 in DE is lower than for other susceptible lines. In addition, the trials carried out in Bad Vilbel have shown that the virulence pattern has remained largely stable over the period 2002-2023, but that virulence against Bt7 can no longer be detected at the site. If absolute infestation levels, annual and environmental effects, interactions with resistance factors etc. are taken into account, the overall picture is much more complex than the illustration in Table 1 suggests. Further investigations should be carried out not only with additional locations and resistances (BtZ, P, Q), but also over longer periods of time.

Literature

Borgen A et al. (2023) Registered varieties and Organic Heterogeneous Material (OHM) with resistance to common bunt in Europe. In: Book of Abstract. XXII International Workshop on Bunt and Smut Diseases, 13.-15. Juni 2023, BOKU Campus Tulln, Österreich

Goates BJ (2012) Identification of New Pathogenic Races of Common Bunt and Dwarf Bunt Fungi, and Evaluation of Known Races Using an Expanded Set of Differential Wheat Lines. Plant Dis. 96(3): 361-369.