Overview of virulence patterns of European common bunt races

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Objective

Common bunt in wheat, caused by the fungal pathogen *Tilletia caries* or *T. laevis*, is a dangerous disease in organic farming that can lead to total crop failure. This article provides an **overview of virulence of European common bunt races and resistances in wheat varieties**. These resistances are based on vertical resistance, in which the genetics are determined by Flor's gene-for-gene relationship:

Each (a)virulence gene of the common bunt fungi has a ⟷ resistance gene of the wheat varieties / lines.

The concrete, practice-relevant objectives of this article are

1. to develop the basis **for site-specific recommendations for resistant wheat varieties** and
2. to develop **measures to contain the spread of virulence.**

Methods & results

The common bunt differential set according to Goates (2012) from wheat lines with the putatively monogenic resistances Bt1 - Bt13 was inoculated with local common bunt races at different locations. The results of these tests were summarised in a literature review and are shown in *Table 1* and *Figure 1*. Coloured (with different colours for the different resistances) fields or circle sections mean that a variety / line with this resistance can be infected by the local common bunt race (i.e. the race is virulent against this gene). *Table 2* also shows the resistance genes for a selection of winter wheat varieties suitable for organic farming.

Table 1: ***Virulence patterns of common bunt races*** *with the specified origin. Virulence is defined as an infestation level of the differential lines above the noted threshold (TH).*

Origin		TH	Virulence (marked in clour) against BtX with X=													Source
Country	Location	[%]	1	2	3	4	5	6	7	8	9	10	11	12	13	
DE	Bad Vilbel (A)	10							X							I
	Darzau (B)															
	Münster (C)															
	Salem (D)															
	Seehausen (E)															
AT	Gerhausen (F)	10														II
	Harmannsdorf (G)															
	Hinzenbach (H)															
	Loosdorf (I)															
	Maissau (J)															
	Sitzendorf (K)															
	Thening (L)															
PL	Winna Góra (M)	<6														III
CZ	Ruzyně? (N)	10														IV
HU	Mix HU (O)	5														V
RO	Craiova? (P)	10														VI
LV	? (Q)	?														VII
CH	Zürich (R)	5														VIII
BG	Sadovo (S)															
SE	Mix SE (T)															
FR	Mix FR (U)	<10														IX
UA	Mix UA (V)	?														X

X At location Bad Vilbel: In extra trials in 2022-23, the virulence against Bt7 observed in 2003-04 could no longer be found.

Table 2: ***Resistance genes in winter wheat varieties*** *with details of the breeding initiative and year of approval according to Borgen et al. (2023)*

Name of variety	Breeding initiative	Year of approval	Resistance gene	
Apostel	Saatzucht Streng-Engelen	2016	Bt5	
Axaro	Probstdorfer Saatzucht	2020	Bt5	
Bosporus	Saatzucht Breun	2016	Bt5	
Butaro	Landbauschule Dottenfelderhof e.V.	2009	Bt7	
Grannosos	Landbauschule Dottenfelderhof e.V.	2020	Bt7	
Roderik	Cultivari Darzau	2018	Bt7	
Thomaro	Landbauschule Dottenfelderhof e.V.	2018	Bt7	
Tillexus	Saatzucht Donau	2018	Bt10	
Tilliko	Cultivari Darzau	2017	BtZ	
Tillsano	Probstdorfer Saatzucht	2020	Bt5	
Trebelir	Cultivari Darzau	2016	Bt7	

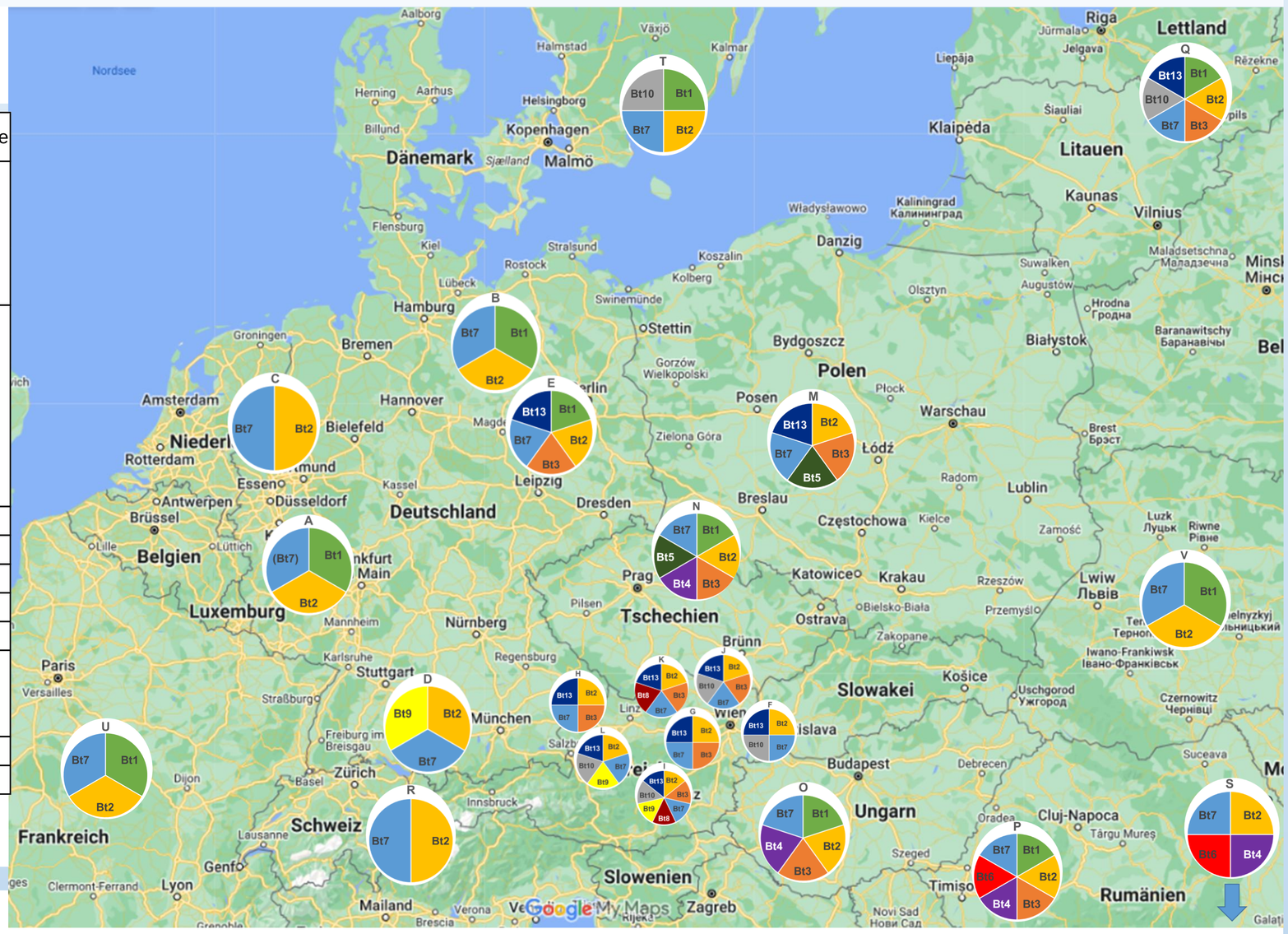

Figure 1: Virulence of European common bunt races; for origin, threshold and source see table 1

Discussion & outlook

1. A comparison of the information from *Table 1/Figure 1* and *Table 2* provides an **initial approximation of site-specific recommendations for resistant varieties**. For example, varieties with Bt5, Bt10 and BtZ resistance (whereby the latter show the same susceptibility patterns) are not susceptible in many places. A special case are varieties with Bt7, which *in practice* in Germany usually remain infestation-free, which is attributed to the influence of the absolute infestation level or other resistance factors.
2. Central measures to contain the spread of virulence are continuous seed analyses (especially in the case of seed saving) and comprehensive advice.
3. Future similar studies should be carried out with additional locations, resistances (BtZ, P, Q) and over longer periods of time, as virulence patterns are not always stable over time, as the trials in Bad Vilbel show.

Sources

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.
I: Wächter R *et al*. (2007) Charakterisierung der Resistenz von Winterweizensorten und -zuchtlinien gegenüber Steinbrand (*Tilletia tritici*) und Zwergsteinbrand (*T. controversa*). Nachrichtenblatt Deutscher Pflanzenschutzdienst, Heft 2, S. 30–39.
II: Ritzer E (2022) Comparing the pathogenicity of Austrian isolates of *Tilletia caries* on wheat (*Triticum aestivum*). Masterarbeit BOKU Wien
III: Kubiak K & Weber Z (2008) Virulence frequency of *Tilletia caries* and the occurrence of common bunt on 20 winter wheat cultivars. Phytopathol. Pol. 47:11-19
IV: Dumalasová V (2021) Reaction of Czech registered varieties and sources of resistance to common bunt and dwarf bunt. International Workshop on Bunt and Smut Diseases 21, Virtual Bunt and Smut Workshop May 5 – 6, 2021
V: Veisz O *et al*. (2000) Effect of common bunt on the frost resistance and winter hardiness of wheat (*Triticum aestivum L*.) lines containing Bt genes. Euphytica 114:159-164
VI: Oncică F *et al*. (2008) Identification of bunt resistance winter wheat lines at the Agricultural Research Development Station-Simnic. Pages 345-348 in: Proc. 43rd Croatian 3rd Int. Symposium Agric., Feb. 18-21, Opatija, Croatia
VII: Matanguihan JB *et al*. (2011) Control of common bunt in organic wheat. Plant disease, 95(2), 92-103
VIII: Blažkova V & Bartoš P (2002) Virulence pattern of European bunt samples (*Tilletia tritici* and *T. laevis*) and sources of resistance. Cereal Research Communications Vol. 30 Nos. 3-4
IX: Orgeur *et al*. (2018) Common bunt: study of predominant virulences in France and development of a resistance test for registration in the French catalogue of common wheat varieties. GEVES
X: Babayants *et al*. (2006) *Tilletia caries* and Resistance of Wheat to this Pathogen in Ukraine. Czech Journal of Genetics and Plant Breeding, 42

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