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Screening of winter barley varieties (*Hordeum vulgare*) for resistance against loose smut (*Ustilago nuda*) and covered smut (*Ustilago hordei*) in Germany.

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Up to now organic farmers depend greatly on conventionally bred and produced varieties of barley. A turning point was set in 2004 by EU regulation No. 1452/2003 restricting the use of conventionally propagated seed and planting material for organic agriculture. Concerning smut fungi in barley, conventional seed producer's attention was rarely directed to plant resistance due to the possibility of chemical seed treatment (controlling the diseases completely). A main problem for organic seed producers is that organically produced seeds have to fulfil the same regular phytosanitary requirements like conventionally produced seeds. For the production of certified seeds not more than five ears infected with *Ustilago hordei* (*Uh*) and/or *U. nuda* (*Un*) are allowed on an area of 150 m² in Germany (RUTZ 1998). Though warm or hot water treatment can give excellent control of *Un* and *Uh* in organic farming (WINTER et al. 1996), the effect is not sufficient for seed production. Even biological control agents (for example Tillecur[®]) cannot reach the demands of the guidelines reliably. As an effective way to keep the restrictions remains the cultivation of resistant varieties. Aim of the presented study was to screen winter barley varieties for their degree of smut resistance in Germany. It started in 2000 (KLAUSE & SPIESS 2003) and is sponsored within the Federal Organic Farming Scheme since 2002.

For infection with *Uh*, one gram of spores per kg of seed was used for inoculation by adding the dry spores to the seeds and shaking them in a glass container (2003) or a plastic bag (2004) to disperse the spores. In 2002/03, the screening for *Uh*-resistance took place at two locations (D-29490 Neu Darchau, D-61118 Bad Vilbel). Plot sizes were 2.4 m² resp. 2.25 m² in three replications at both sites. In 2004/05, the testing was repeated only for the favourites and the updated range of commercially available varieties near Bad Vilbel. The plot size was increased to eight m², three replications again. The number of tested varieties was 91 in 2002/03 and 85 in 2004/05. Main work with *Un* took place near Bad Vilbel. Inoculation was performed following POEHLMANN (1945) by injecting an aqueous teleutospore suspension directly in the ears at the beginning of flowering of each variety individually, when pollen were green or yellowish green. Spores and water were mixed due to the fact, that a slightly dark coloured suspension facilitates the visual control of the inoculation effort, especially for six-rowed varieties (1-2 infected ears per 100 ml H₂O). To imitate an inoculation under natural conditions by wind as well, plots with the infected early flowering variety 'IGRI' (even used for spore suspension) became interspersed within the plot arrangement. Furthermore, spore-suspension was sprayed all over the field with a backpack sprayer repeatedly. Plot size was 1.5 m² (rows 1-6). Artificially infected ears (5-8 per

plot) were marked and protected by a paper bag and were handpicked at harvest. In autumn the artificially inoculated seeds were sown separately (row 1) from those infected by spore drifting via wind (rows 2-6). The degree of resistance was recorded in the following year as percentage of infected ears. The number of tested lines was 274 for the entire study period (including varieties from the world collection of the Federal Centre for Breeding Research on Cultivated Plants, Aschersleben).

The results show great variation in susceptibility to smut. Most of the tested varieties or lines were susceptible, but some varieties had a moderate level of resistance, and only a few were highly resistant. Resistance against *U_b* goes not together with resistance against *U_n*. Against *U_b* only two commercially available varieties showed complete resistance in both test years (Alissa, Uschi). Among those varieties first available in the second testing year, another five showed no visible symptoms (Campanile, Maximiliane, Mercedes, Spectrum, Verticale). Out of 33 varieties with damage below 0.05 %, only 23 were commercially available and could be candidates for a covered smut risk minimized organic cultivation: Allegra, Antalya, Bombay, Cabrio, Camera, Carat, Carrero, Cinderella, Cosima, Dyveke, Elbany, Fee, Finita, Landi, Naomie, Nicola, Passion, Reni, Sarah, Stephanie, Theresa, Tilia and Vanessa. Only the underlined varieties were available for cultivation in autumn 2005 out of organic seed production [www.organicXseeds.de]. Overall 274 lines tested for *U_n*-resistance, the classified damage (0, >0-1, >1-5, >5-10 and >10 %) was 17.2, 23.4, 39.8, 13.1 and 6.6 % for natural infection by wind and 9.5, 3.3, 5.1, 40.0 and 34.7 % for spore injection. Within the group '0 % under artificial infection', only Carrero is commercially available at present in Germany, Astrid and Laurena in Austria. Without damage under natural infection, Jessica and Annicka for Germany and Tundra for Austria can be added. Below 1 % under natural infection remain Elbany, Cabrio, Venezia, Lomerit, Cosima, Barcelona, Nicola and Carat in Germany, Gudrun and Biggi in Austria. Only Lomerit was available out of organic seed production in autumn 2005.

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