Virulence pattern in Danish races of common bunt (*Tilletia caries*) Common Bunt

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Summary: By harvesting fungal spores from partly resistant varieties (as is the practise in normal organic seed production and farming), virulent races of common bunt builds up to devastating levels. The experiment shows that virulence against rare resistance genes to common bunt might be more frequent than expected, since European resistance screening so far have been done without preselecting of virulent races.

Background

Common bunt (*Tilletia caries*) is a seed transmitted fungal disease in wheat. Crop rotation and other measures normally used to controlling plant diseases in organic farming are insufficient to control this type of diseases, and breeding for resistance should therefore have a high priority in organic plant breeding. The quality threshold for bunt infection in wheat is low, with only few infected plants per hectare being enough to exceed the threshold. Absolute control of this disease is in practice needed, and the disease should be considered a quarantine disease in organic wheat production. To achieve this level of control, race specific resistance is needed.

In order to develop resistant wheat varieties based on major genes, it is important to know the virulence pattern of the bunt races in the system, and the resistance genes in the wheat varieties, to select the best parents for breeding.

Main chapter

The aim of this study is to monitor the match of virulences of the pathogen and the resistance of the potential parents in an organic bunt resistance breeding program.

Materials and methods

Spores of common bunt (*Tilletia caries,* syn *T.tritici*) was sampled from different places in Denmark in 2000-2005 by Bent Nielsen, Århus University. The bulk spore sample was used to screen wheat varieties for bunt infection, and maintained by collecting and mixing spores from different susceptible susceptible varieties. Among the wheat varieties, 142 varieties was selected because the showed low susceptibility or in literature was described as resistant. Wheat lines included a differential set of varieties with known resistance genes (Goates 1996). In 2011 and 2012, spores were harvested from the selected infected varieties, and these spores were used to reinoculate the same variety from where they were harvested.

Results

In 2013, 48 out of the 142 tested varieties had an increase of more than 50% of infection level when inoculated with their own spores as compared with inoculating with the bulk spore sample. This increased infection level is interpreted as a sign of virulence being present at a low frequency in the bulk spore sample. 28 lines had no infection at all.

Using this method on the differential varieties for bunt resistance and other varieties with known bunt resistance genes indicated that virulence races were present able to infect varieties having resistance genes Bt-1, Bt-2, Bt-3, Bt-4 Bt-5, Bt-7, Bt-8, Bt-10 and Bt-13, and avirulence were found against Bt-6, Bt-9, Bt-11 and Bt-12. Bt-14 and Bt-15 was inconclusive because of low plant number. Using the traditional setup for bunt trials using only bulk spores would only have identified virulence against Bt-1, Bt-3 and Bt-4, since other virulences were rare in the bulk spore sample resulting in a low infection level in tested lines carrying these resistance genes.

Cross inoculating 28 resistant varieties with spores from 5 other varieties carrying different resistance genes of which virulence had developed, indicated that these 28 varieties could be grouped into 8 groups with similar reactions in terms of infection level, indicating that they may carry the same bunt resistance gene(s).

Discussion

The study shows that virulence against most of the bunt resistance genes are present in the agricultural system in Denmark, ready to multiply once introduced into crops of susceptible varieties. Even virulence against resistance genes like Bt-5, Bt-8 and Bt-10 which is often considered good sources of resistance, were present in the system. These resistance genes can therefore no longer be considered as safe resistance genes.

A strategy for future organic wheat breeding should on this background either be based on pyramiding different resistance genes, or using more rare resistance genes like Bt-11 or Bt-12.

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It is in general not safe to grow organic wheat, unless seed are analysed for the presence of bunt spores before sowing. This study shows that this is also the case for most resistant wheat varieties carrying a single or unknown resistance gene(s).

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References

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