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High damage potential of seed-borne spot blotch in organically grown spring barley in Denmark

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Spot blotch (*Bipolaris sorokiniana*) has for years been considered a minor problem in Danish conventional barley production. This disease is therefore not included in routine disease surveys or official variety testing in Denmark. However, seed-borne spot blotch is known to contribute to reduced seed germination and seedling emergence. Very high seed infection levels of *B. sorokiniana* recorded in Danish organic barley seed may call for more focus on the fungus in the future, particularly in connection with organic farming systems.

Picture 1.

Spot blotch caused by *Bipolaris sorokiniana* (lower arrow) and leaf spot caused by *Ramularia collo-cygni* on spring barley (upper arrow).

Picture by M.S. Hovmøller, DIAS.

The specific aim of this article is to present our first findings on the occurrence and damage potential of seed-borne spot blotch in organically versus conventionally produced barley seeds in Denmark. The work presented is part of two research projects funded by the Danish Research Centre for Organic Farming: 1) the **BAR-OF project** looking into properties of spring barley varieties as related to their suitability for organic production and 2) the **ORGSEED project** dealing with seed health problems in organic seed production.

Importance of spot blotch under Danish conditions

Bipolaris sorokiniana (perfect state: *Cochliobolus sativus*) may cause various diseases on barley including common root rot, seedling blight, black point and spot blotch. Typical spot blotch symptoms on leaves and leaf sheaths consist in oblong (up to 20 mm long), dark lesions (picture 1). Kernel infection may in severe cases show as black point symptoms. Infections can cause substantial reduction in kernel size and yield.

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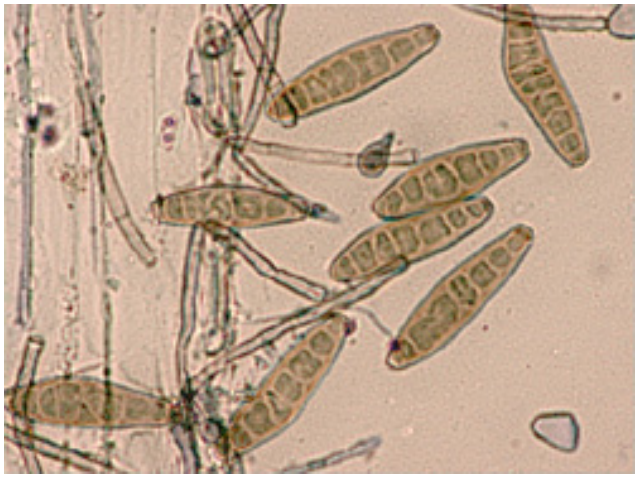
Primary inoculum may be seed-borne or it may come from plant residue or wild grasses from which it is spread by air-borne conidia (picture 2). Seed-borne inoculum in particular may be contributing significantly to the development of brownish roots and coleoptiles resulting in seedling blight. A range of other fungi (particularly *Fusarium* spp.) may contribute to this seedling blight as well.



Picture 2.

Conidia of *Bipolaris sorokiniana* with attached conidiophores under the light microscope.

Seed infection with these root-damaging fungi including *Bipolaris sorokiniana* is in Denmark monitored in a volunteer scheme in which seed infection thresholds are in force. Seed infected with more than 15% (winter barley) and 30% (spring barley) of a range of root damaging fungi including *B. sorokiniana* is recommended not to be used as untreated seed material. The threshold level is the same for conventional and organic barley seed.

Spot blotch of barley occurs almost everywhere where barley is grown but its severity varies greatly, depending on the environmental conditions. Extended periods of warm, moist weather may favour epidemic development that can lead to high yield losses. In Denmark, severe spot blotch epidemics have hitherto been considered to be rare. However, the expected warmer summers as a consequence of global warming may bring more favourable conditions for the fungus and the fungus may gain more importance through more damage to barley.

Because *B. sorokiniana* is seed-borne, the use of healthy seeds is an important part of the control strategy. Other control options available to organic growers consist in the use of resistant cultivars and the reduction of primary inoculum in crop residue via crop rotation with non-susceptible crops or by means of tillage practices that bury crop residues or facilitate their rapid breakdown.

Comparison of infection levels under organic and conventional conditions

About 120 spring barley varieties were grown in field plots under organic production conditions (mechanical weeding, application of organic manure and no seed treatment) as well as conventional conditions (seed treated with fungicides, application of herbicide and mineral fertiliser) at three sites in Denmark in 2003. The harvested seed of the varieties Alliot, Goldie, Lux, Mentor, Neruda and Pongo were analysed for infection with *B. sorokiniana* by the blotter method. The germinating ability of the seeds was assessed in separate analyses. Data (Figures 1-3 and Tables 1-3) as described below are shown in the **attached PDF-file**.

The percent seed infection with *B. sorokiniana* ranged from about 5 to 95%

and was highly dependent on the site, production system and variety (Figure 1 and Table 1). Infection levels of seeds from organically cultivated plots were about twice as high as those of seeds from plots receiving conventional treatments (Figure 1). The germinating ability of seeds was highly affected by the level of *B. sorokiniana* infection (Table 2) and declined drastically at contamination levels above 60% (Figure 2). This effect appeared to differ among varieties (Table 2). The 1000-grain weight was primarily affected by the site and variety, but not by the level of spot blotch infection of the seeds (Figure 3, Table 3).

Knowledge on variety resistance is required

Spot blotch infection levels and the associated damaging effects in terms of reduced germinating ability of seeds were extremely high in seeds harvested from organically managed fields. Our results indicate that the importance of spot blotch may be underrated, especially in organic barley production, which entirely depends on organically produced seeds. Our results furthermore indicate that varietal resistance may play an important role in spot blotch control. This should be further investigated, especially because no information is currently available about the resistance against spot blotch of barley varieties on the Danish variety list. More results are expected from ongoing seed analyses of trials conducted in 2004.

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