



Certain health-promoting cereal varieties are more resistant to fungal infection

Fusarium infection of cereals present a risk to health because these fungi produce so-called mycotoxins, toxic substances that are dangerous to humans. Within NRP 69, a research group investigated the factors that could reduce the risk of mycotoxin contamination. They observed that a modified crop rotation can reduce infection. Furthermore, certain wheat, oat and barley varieties with particularly high levels of health-promoting compounds, such as antioxidants and beta glucans, are more resistant to *Fusarium* infection.

Not all cereals are the same. Some varieties contain more health-promoting compounds such as beta glucans or antioxidants. Hence, the cultivation and consumption of healthier wheat, barley and oat varieties is encouraged. To be truly healthy, cereals should not contain mycotoxins. These toxic substances occur when cereals are infected with *Fusarium* fungi. Within NRP 69, researchers from Agroscope investigated the factors that could reduce the risk of mycotoxins accumulation in wheat, oats and barley, and also whether certain cereal varieties are less frequently contaminated with mycotoxins. In the course of their work, they investigated in particular whether varieties with a high content of

health-promoting compounds are less susceptible to fungal infection. Earlier laboratory studies suggested that wheat varieties with a high content of health-promoting antioxidants were more resistant to fungal infestation. Thus, the project investigated under field conditions the correlations between these compounds and *Fusarium* resistance in wheat, oats and barley.

In a first step, the research group carried out a nationwide survey of barley and oat samples to analyse the cropping factors that have an influence on the species infected with the predominant *Fusarium* species and the resulting contamination with different mycotoxins. It was observed

Agroscope researchers conducted field experiments at three locations in Switzerland. Various cereal varieties in one of the experimental fields in the Canton of Zurich.



that barley samples from fields with maize as the previous crop contained higher levels of mycotoxins. In contrast, higher mycotoxin concentrations were detected in oat samples from fields with small grain cereals as the previous crop. For both cereal types, infection levels were lower if the fields had been ploughed before sowing. This result highlights the dilemma between food safety and soil fertility, since ploughing reduces fertility.

In a second step, the researchers carried out growth chamber and field experiments to investigate the effects of three environmental factors – temperature, duration of exposure to humidity and growth stage – on mycotoxin contamination. Barley proved to be more susceptible at 15°C than at cooler (10°C) or warmer (20°C) temperatures. Furthermore, prolonged exposure to humidity increased mycotoxin infestation. Compared with wheat, barley was at all growth stages consistently and significantly more susceptible to *Fusarium* infections. Furthermore, oats were more susceptible at lower temperatures (10°C), in contrast to earlier analyses, which had identified warmer conditions as a risk factor. Oat plants were found to be particularly susceptible at the flowering stage. Unlike barley, there was no clear evidence that a longer period of humidity exposure had any effect on the infection of oats.

The third step of the project was to analyse the genetic resistance factors of different cereal varieties. Various modern varieties as well as varieties with an elevated content of health-promoting compounds were grown in fields in three different areas of Switzerland and artificially infected with the respective dominant *Fusarium*

Extending the forecasting system FusaProg to barley

The FusaProg forecasting system is a nationwide service from Agroscope that provides information on the regional and cropping related risk of *Fusarium* infection in wheat. It has been available to wheat producers since 2007, helping farmers to decide whether or not to apply fungicides. In the light of their project results, the researchers are now extending the information system to barley. For oats, more research is needed to understand the life cycle of the respective dominant *Fusarium* species before the platform can be extended to oats.

species. The researchers evaluated the percentage of infected ears, and, post-harvest, the grain weight, the amount of health-promoting compounds and the concentration of the different mycotoxins. The findings indicate that a higher antioxidant level does not necessarily provide greater resistance to fungal infection. However, several wheat varieties with an elevated antioxidant content were proven to be less susceptible. The experiments also showed that barley grains per se contain fewer mycotoxins. Furthermore, the project demonstrated that barley varieties with a high beta glucan content accumulated lower levels of mycotoxins. The same applied to the investigated oat varieties. Although oats are also susceptible to *Fusarium* infection, the experiments showed that the toxins accumulate primarily in the husks, which poses less of an issue in oats intended for human consumption.

Further
information:
www.nrp69.ch

Recommendation

Fewer fungicide applications thanks to an adjusted crop rotation

To avoid *Fusarium* infection and the resulting mycotoxin contamination, cereal producers should primarily modify crop rotation patterns. Barley should not be sown in fields where maize was the previous crop, while oats should not be grown after small grain cere-

als. The risks arising from crop rotation could be further reduced by ploughing and sowing less susceptible cereal varieties. By following these recommendations, the need for fungicides and their negative impact on the environment can be substantially reduced.