Fusarium Mycotoxins in Forage Maize – Occurrence, Risk Assessment, Minimization

E. Oldenburg*, F. Höppner

Federal Agricultural Research Centre (FAL), Institute of Crop and Grassland Science, Bundesallee 50, D-38116 Braunschweig, Germany
* Corresponding Author

Abstract

The deoxynivalenol contents of forage maize in this study ranged between 0.22 and 12.9 mg/kg DM, but seldom exceeded critical concentrations suggested for ruminant diets. Zearalenone was found in considerably lower concentrations than DON and rarely reached critical levels. Therefore risk to the health and performance of ruminants is regarded as low. Fusarium toxin occurrence in forage maize can be minimized by choosing maize varieties less susceptible to stem rot, harvesting at optimal maturity (dry matter content 30-35%) and elevating the cutting height to at least 40 cm above ground.

Keywords: deoxynivalenol, zearalenone, forage maize, minimization

Introduction

Forage maize is an important crop for feeding beef cattle/dairy cows. In Germany, the production area for forage maize is about one million ha at this time, with an annual production of about 50 million tons of green plant material. Harvested fresh forage maize is conserved by ensiling before being fed to ruminants. The proportion of silage varies between 40-100 % of total diet for cattle/dairy cows.

The German Federal Ministry of Consumer Protection, Food and Agriculture published critical concentrations (orientation values) of the Fusarium mycotoxins deoxynivalenol (DON) and zearalenone (ZON) in ruminant diets (2000). Maintenance of these concentrations ensures that no adverse effects on animal health occur if all other conditions (e.g., management, stress, housing) are optimised (1). As forage maize frequently contains mycotoxins produced by Fusarium (2), a study on the occurrence of deoxynivalenol and zearalenone in forage maize was carried out in order to assess the health risk to ruminants. Strategies are proposed for minimizing the risk of forage maize contamination with Fusarium mycotoxins.
Materials and Methods

Forage maize samples were derived from a nationwide variety experiment carried out in cooperation with the University of Kiel (Institute of Crop Science and Crop Breeding), the German Maize Committee, regional stations for variety testing and maize breeding companies.

Fresh whole plants of eight varieties with different ripening behaviour and susceptibility to stem rot, harvested from 11 German locations in 2000 (figure 1), were analysed for deoxynivalenol with ELISA (Ridascreen Fast DON, R-Biopharm, Darmstadt, Germany; detection limit 0.22 mg/kg). Zearalenone was determined in selected samples containing DON by ELISA (Ridascreen FAST Zearalenon, R-Biopharm, Darmstadt, Germany; detection limit 0.1 mg/kg).

Plants were harvested by hand (10 plants per variety, cut directly above the crown roots) at different stages of maturity (dry matter contents 30, 35 and 40%), subsequently chopped, oven-dried at 80 °C and ground to pass through a 1-mm sieve before analysis.

For the cutting experiment, the same eight varieties were cultivated at Braunschweig (FAL) in 2000/2001. Different cutting heights of 20, 30 and 40 cm were adjusted on the harvester, and resulting harvest material was analysed for deoxynivalenol by ELISA as described above.

Figure 1: Locations of variety experiment in 2000

Table 1: Critical concentrations of deoxynivalenol and zearalenone in diets for ruminants (mg/kg, 88% dry matter) (German Federal Ministry of Consumer Protection, Food and Agriculture, 2000)

<table>
<thead>
<tr>
<th>Animal type</th>
<th>Deoxynivalenol</th>
<th>Zearalenone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-ruminant calves</td>
<td>2.0</td>
<td>0.25</td>
</tr>
<tr>
<td>Female rearing cattle/Dairy cows</td>
<td>5.0</td>
<td>0.50</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>5.0</td>
<td>- *</td>
</tr>
</tbody>
</table>

* according to current knowledge no critical concentration is necessary