OCCURRENCE AND FATE OF TOXIGENIC FUNGI AND THEIR ASSOCIATED MYCOTOXINS IN SASKATCHEWAN-GROWN OATS AND OAT MILLING PRODUCTS
Summary Report March 2017 – February 2018

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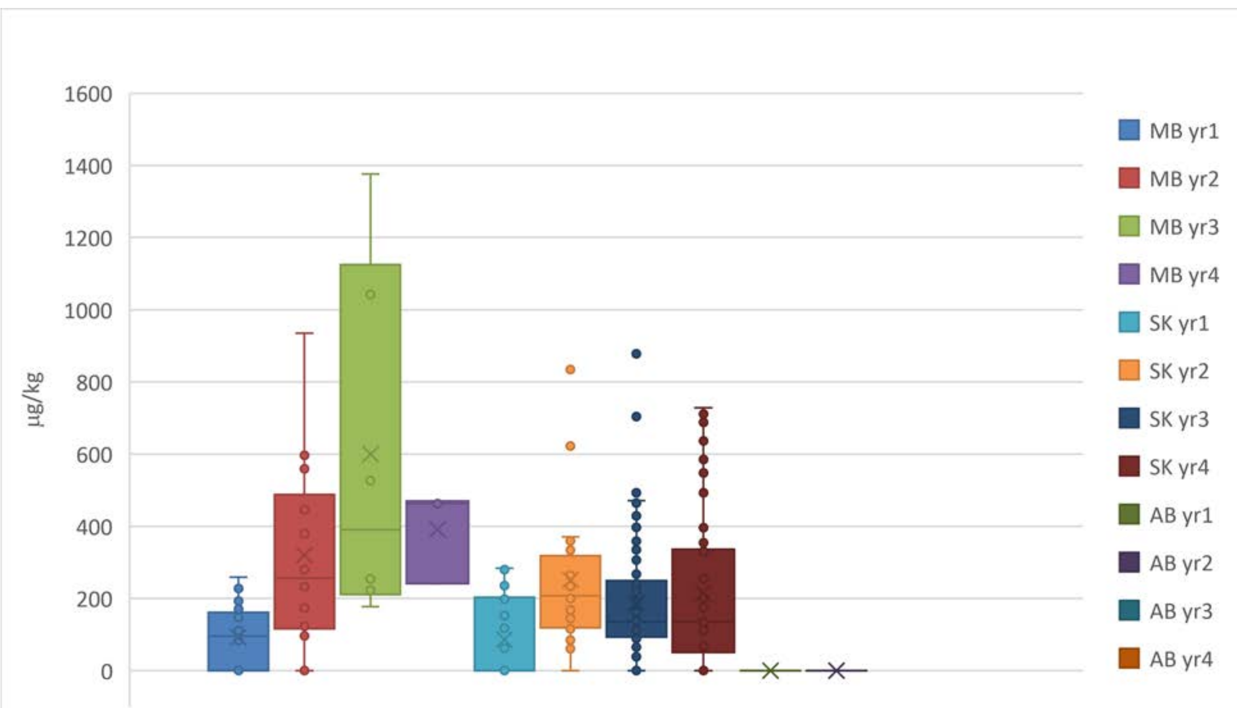
Activity 1. Occurrence of toxigenic Fusarium and Penicillium fungi and their associated mycotoxins

There was only slight change in the geographic distribution of mildew-causing *Alternaria* species and other plant pathogens such as *Fusarium* in 2017. Overall frequency of fungal pathogens in 2017 oats was lower than in any previous years. This observation is in accordance with the low disease incidence observed in 2017 wheat samples from across western Canada. Pathogen diversity in oat samples was comparatively low. *Fusarium graminearum,* the main deoxynivalenol (DON) producer, was occasionally detected in oat samples from the Red River valley in MB, and only at low levels (<4% of kernels). As in previous years, species of *Alternaria*, which are often associated with leaf diseases, were the most abundant pathogens of oats. *Penicillium verrucosum*, the producer of ochratoxin A (OTA), was not detected in 2017 oat harvest samples.

The most frequently detected mycotoxins were associated with *Alternaria* fungal species and *Fusarium avenaceum*. Other *Fusarium*-produced mycotoxins were found frequently as well, such as DON in 80% of samples. OTA was found at a frequency double the previous year (16%).

Figure 1. Deoxynivalenol (DON) and related *Fusarium graminearum*-produced mycotoxins in oat deliveries and rail car loadings. Samples are organized by province of receiving or shipping facility. The boxes represent the 25-75th percentile, the whiskers represent the 10-90th percentile, and the line within the box represents the median value.



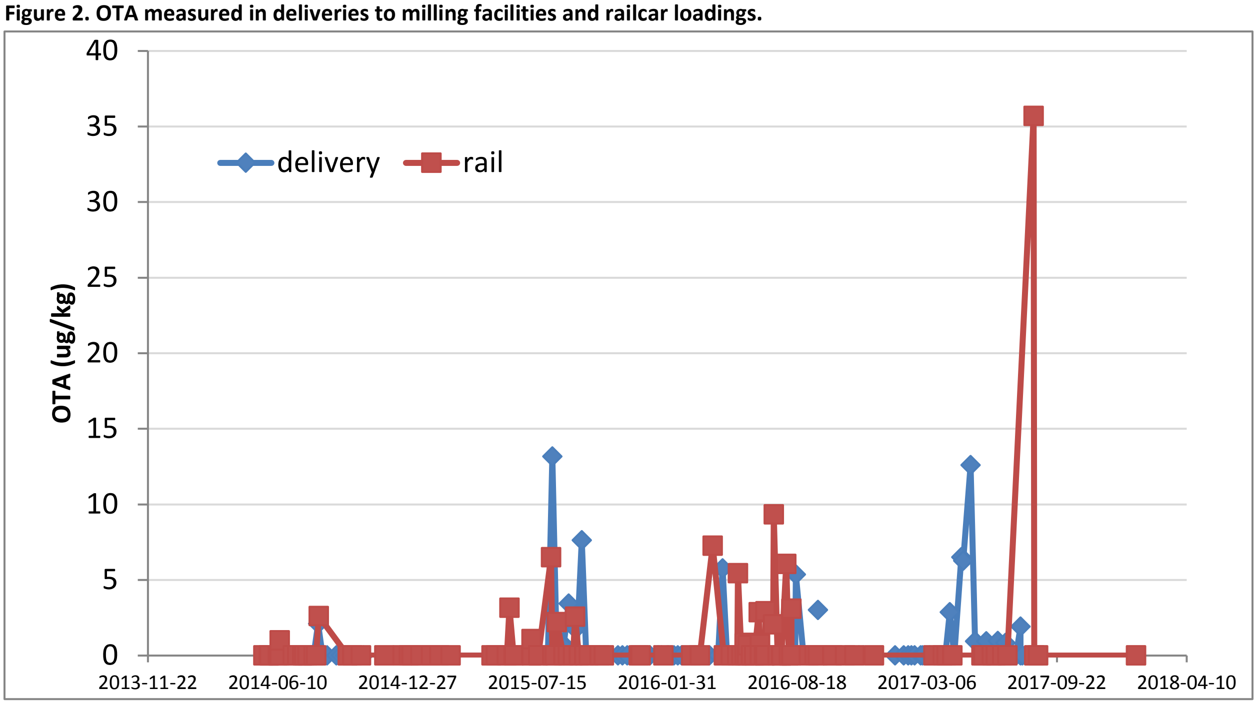
Median concentrations of mycotoxins were below existing established maximum limits (ML; eg. European Union: 5 µg/kg OTA, 1750 µg/kg DON in unprocessed oats). However, there were instances where concentrations in individual samples exceeded MLs. Three deliveries and one rail car composites contained OTA at concentrations over 5 µg/kg. In addition, three oats harvest survey samples contained DON at concentrations over 1750 µg/kg.

Figure 1 shows results over the four years of the project for DON compounds in deliveries and railcar loadings of oats.

Year and location are factors that govern the presence of toxigenic pathogens and subsequent mycotoxin production. DON concentrations showed variation correlated with project year and sample origin location. In the oat deliveries/rail car loadings sample set, median DON concentrations were highest in MB the last two years of the project. No samples representing railcar loadings of oats from stations in Alberta were available from industry partners in years 3 and 4 of the project.

Since OTA is produced in storage, and not in the field (as opposed to DON and related mycotoxins), almost all incidences of occurrence were in samples that were stored (ie. oat deliveries or railcar loadings) as opposed to harvest samples. OTA is observed in late summer/early fall (Figure 2). This cyclic occurrence and peak in oats sampled in the late summer/early fall has also been noted for wheat. The peak is likely due to grain being stored for longer, and experiencing warmer storage conditions that promote fungal growth and toxin production, than grain moved earlier in the calendar year.

Figure 2. OTA measured in deliveries to milling facilities and railcar loadings.



Activity 2. Investigation of the fate of Fusarium and Penicillium species and their associated mycotoxins during processing of oats.

The effect of de-hulling and conventional steaming and kilning on mycotoxin concentrations was evaluated. Samples of oats obtained from various sources were screened for higher mycotoxin concentrations, but only four samples with relevant levels were found. These four samples were de-hulled, and groats, hulls, and any remainder (kernels that could not be de-hulled) fractions were all analyzed for mycotoxins. A portion of the groats was retained, steamed and kilned on a laboratory scale, and analyzed for mycotoxins.

Mycotoxins were mainly associated with hulls. The samples used in this experiment contained a number of *Fusarium*-related mycotoxins, including DON. Approximately 80% of the DON in the oat samples was associated with the hulls, suggesting that removal of hulls results in a substantial reduction of mycotoxins in oats. There was no consistent changes in mycotoxin content of groats after heat treatment. The results so far support that exposure from the consumption of oats must be estimated using occurrence data for groats to avoid significantly overestimating potential risk to consumers.

Please note: These results are interim results. The final report will be prepared in 2019 after compiling all the data from the completed project.

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