FUSARIUM SPP. ASSOCIATED WITH EAR ROT OF MAIZE IN THE MURRUMBIDGEE IRRIGATION AREA OF NEW SOUTH WALES

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Abstract

In February 2003 maize (Zea mays) cobs on crops in the Murrumbidgee Irrigation Area were found to be infected by a fungus close to harvest. The cobs were covered in white fungal growth. Maize cobs and plants were collected and sampled to identify Fusarium species on kernels and those that were endophytic in stems and peduncles. The dominant species was F. verticillioides. Cobs also were also damaged due to the corn ear worm (Helicoverpa). It was considered that dry conditions previously and rainfall close to harvest contributed to the disease outbreak. Maize plants were separated into stems, leaves, kernels and the cob core to identify the levels of fumonisins within them. Kernels yielded the highest however the core and stems also recorded fumonisins.

Introduction

Maize has been expanding in the Griffith region of NSW which is centred in the Murrumbidgee Irrigation Area (MIA). The expansion has been to supply the adjacent cattle feedlot industry and for the supply of corn for human consumption. Also larger areas of maize had been planted due to the reduced availability of feed because of the severe drought in 2002.

In the 2002/03 season maize crops in the MIA developed ear rot. Whole cobs were covered with white hyphae. There were direct yield losses from lower grain weights and rejection of whole loads by stockfeed companies due to the presence of mouldy grain.

Ear rot can be caused by fungi belonging to the Gibberella fujikuroi species complex and by Gibberella zeae. The G. fujikuroi group which includes F. verticillioides, F. proliferatum and F. subglutinans are the main species that infect corn. Part of this group had previously been referred to as F. moniliforme. These fungi can enter plants through the seed, silks, stalks and roots or can be associated with damage due to Helicoverpa or the corn earworm. This damage is usually restricted to the tip of the cob. The fungi can also be endophytes, able to grow within the plant without producing symptoms until plant stress induces disease development.

Gibberella zeae (F. graminearum) can also cause stalk and ear rot of corn and head blight of wheat.

Fusarium species can produce a range of mycotoxins, for example F. verticillioides produces fumonisins which can affect horses and pigs and have been associated with causing oesophageal cancer in humans.

Materials and methods

Cob damage

Affected crops were assessed for cob damage due to Fusarium infection, insect damage and those that were healthy. Weather data was collected for the area where the problem occurred.
Fusarium isolation

Maize plants from six affected crops were collected at the time of the disease outbreak. Fifty plants were collected immediately prior to maturity, one crop from each property. The stems were cut at the base around the first node and a segment or “piece of pie” was plated onto selective media, peptone PCNB Agar. Fifty peduncles were also collected from the same plants and the same procedure was followed. In some cases only peduncles were sampled.

Fusarium colonies which developed on the isolation plates were subcultured onto either Carnation Leaf Agar (CLA) or Water Agar with 5 cm square disks of sterile filter paper placed on the agar surface. These cultures were purified by transferring single spores to CLA, grown for 7-10 days and identified according to Burgess et al. (1994).

Fumonisin analysis

Seventy two samples of harvested grain were sent by growers for the determination of fumonisin levels at Agrifood Technology, Werribee, Victoria. Five seeds of eighteen of these samples were placed onto PCNB Agar and colonies of Fusarium isolated were identified as in the method described above.

Plant part fumonisin levels.

Whole plants were collected from three of the more affected crops and separated into grains, cores (cobs with the grains removed), stems and leaves for specific plant part fumonisin levels. Samples of chopped whole plants (silage) from the same crops were also tested for fumonisin levels.

Results

Cob damage

A large number of cobs were affected by both Fusarium and Helicoverpa as seen in Figure 1. Farm 3 had all cobs assessed having Fusarium infection. Some of the cobs were totally covered by fungus. The outbreak of the disease appeared to coincide with a season of dry conditions and rainfall of up to 100 mm in the previous week, combined with high humidity.

Fig. 1. The percentage of cobs affected by Fusarium, Helicoverpa and those remaining healthy.
**Fusarium isolations**

From the maize crops sampled species isolated in decreasing frequency included, *Fusarium verticillioides*, *F. proliferatum*, *F. subglutinans*, *F. nygamai*, *F. graminearum*, *F. semitectum* and *F. equiseti*. Both stems and peduncles had similar results as seen in Figures 2 and 3.

**Fumonisin analysis.**

The level of fumonisins in the grower collected grain samples ranged from <200 ppb to 11 ppm (<0.2 to 11 mg/kg). The maximum level of fumonisin recorded was 152ppm, which was badly infected grain that had been graded out from a bulk harvested sample. The dominant species in the kernels from the grower samples was also *F. verticillioides*.

**Plant part fumonisin levels.**

The levels of fumonisin in the plant parts appear in Figure 4. Leaves had negligible fumonisin levels. The core had significant levels of fumonisin.
Discussion
The consequences of this outbreak were highlighted by crop rejections from feedlots and other consumers. Plant stress is considered as a major contributing factor in the development of ear rot. The maize problem occurred in a season where water stress was common. Other factors that could have contributed to disease include minimal breakdown of the previous year’s stubble (due to the drought); crop residue can be a source of inoculum of the fungi. There was also a high level of grub (Helicoverpa) damaged cobs as shown in Figure 1 and this also would have accentuated Fusarium infection. Maize crops had also been planted with high plant populations that could have increased stress. High rainfall just before harvest could have contributed to the problem in the more seriously affected crops. Because some maize crops were so badly infected (Farm 1 and 2) they were not harvested for grain, instead the whole crop was chopped for cattle feed. Other affected crops were harvested as normal and graded to remove as much affected grain as possible.

The dominant species of Fusarium were F. verticillioides and F. proliferatum both of which produce fumonisins. Toxin levels detected in the growers’ samples were not high enough to affect cattle but high enough to affect pigs and horses. The presence of diseased grain delivered to stockfeed companies caused rejection of whole loads due to the growers’ contract term of nil acceptance of “mouldy grain”.

Reducing levels of Fusarium in corn can be improved by reducing insect attack and growing varieties that are adapted for local conditions (Munkvold 2003).

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References