Foliar FUNGICIDE SPRAY regimes:

A handy tool to fight maize ear rots

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MAIZE WITH A HIGH YIELD POTENTIAL IS OFTEN MORE SUSCEPTIBLE TO CERTAIN DISEASES, RESULTING IN THE USE OF PROPHYLACTIC FUNGICIDE SPRAY PROGRAMMES. SINCE 2007 A SIGNIFICANT INCREASE IN THE USE OF FUNGICIDES IN MAIZE PRODUCTION HAS BECOME PROMINENT TO PREVENT AND/OR CONTROL FOLIAR DISEASES.

An increase in the market price of maize has helped to make fungicide sprays economically viable. Foliar fungicide spray programmes usually include a combination of strobilurin and triazole at the five-leaf to eight-leaf stage of plant growth, followed by a second spray of triazole 28 days to 30 days after the first spray. No fungicides are currently registered to control Fusarium ear rot diseases and their subsequent mycotoxins. The aim of this study was to determine whether prophylactic fungicide regimes for foliar diseases could reduce the risk of colonisation of grains by *Fusarium verticillioides* (**Photo 1**) and *F. boothii* (**Photo 2**) and their resultant mycotoxin production.

F. verticillioides and *F. boothii* are two of the predominant maize fungal ear rots that can cause a reduction in grain quality as well as the production of mycotoxins that can be detrimental to humans and animals. *F. verticillioides* can produce fumonisins B_1, B_2, and B_3 and *F. boothii* can produce the estrogenic metabolite zearalenone (ZEA) together with the nivalenol (NIV) and deoxynivalenol (DON) mycotoxins.

PLOT TRIALS

Randomised split-split plot trials were conducted during the 2018/2019 planting season under dry land conditions with three replicates per treatment at:

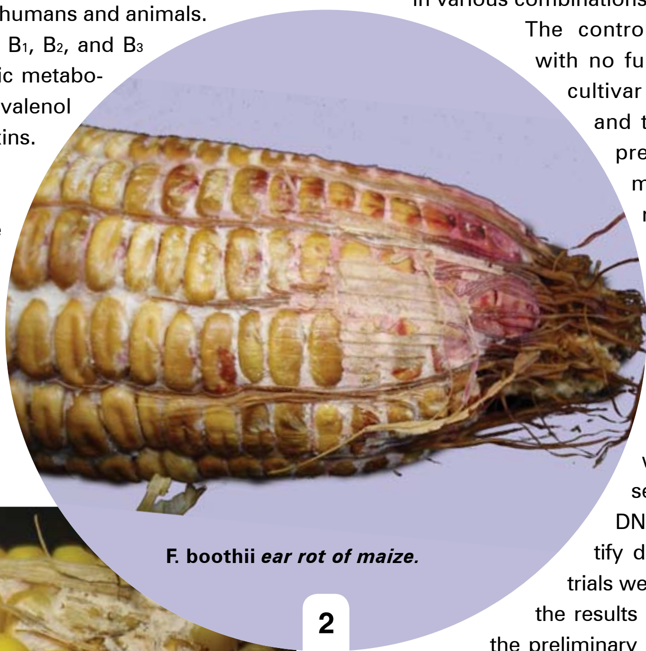
- Potchefstroom (warm, dry production area in the North West Province);
- Cedara (subtropical production area in KwaZulu-Natal); and
- Vaalharts (semi-desert area in the Northern Cape).

The whole-plot factor represented days of spray applications and the second main effect, spray combinations. The sub-plot effect was cultivar. Two maize cultivars (BG3292 and BG3492B) were used and trials were maintained according to best practice appropriate to the respective production areas. Experimental plots were monitored for the five-leaf to twelve-leaf, pre-flowering, flowering and soft dough stages of plant growth.

Active ingredients from the triazole, strobilurin and benzimidazole fungicide classes, currently being used by producers as prophylactic fungicides for the prevention and control of foliar diseases, were tested in various combinations (**Table 1**).

The controls included naturally infected plants with no fungicide treatment. Four rows of each cultivar in an experimental block were planted and the middle two rows were sprayed to prevent fungicide drift to other experimental blocks. The outer two rows represented the controls. During silking, maize ears of one middle row was inoculated with *F. verticillioides* and the other one with *F. boothii.* Plants were scouted throughout for leaf diseases and stalk borers.

Plots were individually harvested and rated, threshed and milled. Samples were subjected to qPCR and HPLC analyses to determine the amount of fungal DNA present in grain samples and to quantify different mycotoxins, respectively. These trials were repeated in the 2019/2020 season and the results are currently being analysed. Therefore, the preliminary results of the 2018/2019 season are discussed in this article.



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F. boothii ***ear rot of maize.***

1

F. verticillioides ***ear rot of maize.***

Results showed that the inoculation method was effective, as target DNA fungal biomass was significantly higher compared to the naturally infected plants. Infection of maize grain by *F. verticillioides* and *F. boothii* (target DNA) varied over the three localities and was the highest in Cedara and the lowest in Potchefstroom.

In this study period, cultivar BG3292 was always more susceptible to fungal infection and mycotoxin production in maize grain, compared to its isoline BG3492B. The highest fumonisin levels were recorded at Potchefstroom in cultivar BG3292 and overall, DON and ZEA levels were quantified in low amounts. None of the mycotoxin levels exceeded South African regulatory limits. In some instances, only cultivar as main variable had an effect on mycotoxin production in maize grain.

1 ***Fungicide spray combinations and time of application.***

	First spray	Second spray
1st combination	Amistar Top (Azoxystrobin 200 g/ℓ + Difenoconazole 125 g/ℓ) five leaf stage* eight leaf stage* eight leaf stage* ten leaf stage* 12 leaf stage*	Artea (Cyproconazole 80 g/ℓ + Propiconazole 250 g/ℓ) 28 days later (pre-flowering stage) 28 days later 42 days later (flowering stage) 28 days later (flowering stage) 56 days later (soft dough stage)
2nd combination	Abacus (Pyraclostrobin 62,5 g/ℓ + Epoxiconazole (62,5 g/ℓ)	PunchXtra (Flusilazole 125 g/ℓ + Carbendazim 250 g/ℓ)
3rd combination	Amistar Top (Azoxystrobin 200 g/ℓ + Difenoconazole 125 g/ℓ)	PunchXtra (Flusilazole 125 g/ℓ + Carbendazim 250 g/ℓ)
4th combination	Abacus (Pyraclostrobin 62,5 g/ℓ + Epoxiconazole (62,5 g/ℓ)	Artea (Cyproconazole 80 g/ℓ + Propiconazole 250 g/ℓ)

** Application times will be the same for all fungicide combinations*

SUMMARY

This is the first time that it could be proved that certain fungicide spray combinations can reduce fungal infection (in Cedara and Potchefstroom), which is an added advantage for producers. The non-significance of application dates is also a positive finding as producers do not need to add extra sprays to the existing prophylactic fungicide regimes (to include a later spray), which means that extra costs are avoided.

It must be noted that in an environment conducive for fungal infection such as Cedara, the 50% growth reduction of *F. verticillioides* target DNA levels (1 335,2 pg μg^{-1}, 1 140,5 pg μg^{-1} and 1 123,4 pg μg^{-1}) is still relatively high and can be considered as a yield constraint. Therefore, the reduction of fungal infection by certain fungicides should be seen as an added advantage, but should be used in an integrated pest management system to mitigate maize ear rot infections and their related mycotoxins.

It is reported in literature that the stress of fungicidal treatments can affect other facets of fungal metabolism, including sporulation and secondary metabolite (mycotoxin) accumulation. In this study elevated mycotoxin levels were not recorded for fungicide spray combinations and this will be closely monitored in the second year data that will follow. ■

Supplements for animals...

the morning and 30 minutes in the evening on the first day. Extend this period every day to ad lib grazing on Day 7. Never place hungry animals on the grazing. Animals should always have access to roughage of good quality that is available ad lib during the adjustment.

Prussic acid poisoning is a significant challenge. The primary driver is plants that are under stress, for example limited moisture (wilted) or cold (frost). Major differences occur between species with respect to prussic acid and a combination of environmental factors can affect this.

Sulphur in the lick can help, but the only real solution is prevention. Grazing should not be used where this problem is suspected.

Diarrhoea can occur, particularly during the adjustment period. The roughage will help for this. Intake will be low, but will suppress the diarrhoea. The diarrhoea should not be confused with dung that is loose and greenish in any case on this type of grazing. Feed lime in the supplement will have no effect on the diarrhoea.

Vitamin B deficiencies can occur together with the diarrhoea because incomplete synthesis takes place as a result of the rapid rumen through-flow rate. This is characterised by typical nerve symptoms. Vitamin B can be supplemented (injectable) and roughage can be provided to limit the rumen through-flow rate.

A magnesium deficiency is a possibility that can occur due to the inherent properties of the grazing and supplements, which can lead to an induced deficiency. Symptoms are similar to those of animals with milk fever, characterised by paralysis. Magnesium solutions can be administered intravenously, but this must be done timeously – animals will die if they move past a critical point. The best treatment is prevention, and if problems are expected, 1% magnesium sulphate (Epsom salts) or magnesium oxide can be added to the lick.

In particularly wet seasons, foot rot can be a problem because of hooves that remain soft. Adding 1% zinc sulphate/oxide to the supplement can help prevent this problem. In addition, preventive vaccination for lung-related diseases is essential. Parasite control is obvious.

If Grade 2 and 3 maize is used in the supplement, do not lose sight of mycotoxin poisoning. This is also characterised by typical nerve symptoms. Toxin binders can be mixed into the supplement as a preventative measure.

CONCLUSION

In general, cover crops are high-quality grazing that requires relatively simple supplements that have to be managed on a daily basis. Although a few potential challenges have been mentioned, the grazing is mainly safe and can be utilised successfully with good management.

It remains important to determine the aim of the planting when planning the planting of cover crops, to decide on the animals and system to be used, and to select the lick supplements in collaboration with the nutritionist. If this is not done, the profit will not be maximised. ■