



Fig. 1: Grey-green spore infestation on the husks.



Fig. 2: Germination of the grain on the cob.



Fig. 3: Watered-down cob covered with spores.



# TRICHODERMA UNDER THE MICROSCOPE

For a long time, fungi of the genus *Trichoderma* were considered useful aids in plant cultivation – known for their antagonistic effect against soil-borne pathogens and their use in biological plant protection products and biostimulants. This makes current observations from practice and research more surprising: *Trichoderma afroharzianum* as a pathogen on maize cobs.

## What is *Trichoderma*?

*Trichoderma* is a widespread genus of fungi that occurs naturally in soils, plant residues and on roots. Many of its representatives are known to displace other fungi, promote plant growth or stimulate root development. For this reason, *Trichoderma* strains have been used for years as active ingredients in biological plant protection products and soil additives.

In practice, they have been considered „beneficial microorganisms“ up to now. However, the genus is extremely species-rich – and not all representatives are harmless. Recently, there has been increasing evidence that certain *Trichoderma* strains can also have a plant-pathogenic (damaging) effect – especially on maize.

## *Trichoderma afroharzianum* as a pathogen

The first indications of a pathogenic role of *Trichoderma afroharzianum* in maize came from Germany in 2018. Since then, the fungus has been increasingly detected under field conditions on diseased maize cobs in France, Austria, Italy, Turkey and China.

Typical signs of infection are cobs with grey-green spore infestation and premature germination of the grains on the cob at the sites of infection. In addition, the cob appears watery and the grains can be easily crushed by hand (Figs. 1–3). It has been shown that the pathogen infects mainly under hot and dry weather conditions during maize flowering. Due to its green spore infestation, the fungus can easily be confused with other common moulds such as *Aspergillus* or *Penicillium*, which makes a reliable diagnosis difficult.

The „Tricho-Maize“ project showed that *T. afroharzianum* causes severe damage to maize cobs and can reduce yields by up to 55%. This is due to the production of alpha-amylase, which converts starch into glucose and causes premature germination of the grains. In addition to maize, other cereals can also be affected, negatively impacting the thousand-grain weight. Applying fungicide during flowering can reduce infestation, but this is not feasible in organic farming. There were hardly any differences in susceptibility between maize varieties: of 22 commercially available varieties tested, only two showed a slight reduction in infestation severity. These results indicate that there is

currently little genetic resistance to *T. afroharzianum* in the maize varieties currently being cultivated.

The fungus is also attracting increasing international attention: a recent study from India describes *T. afroharzianum* for the first time as the cause of stem rot in maize, underlining its potential significance as a systemic pathogen. In Italy, the fungus has also been documented as the cause of seed rot – an indication that, under certain circumstances yet to be identified, seeds could also be affected.

## Biological fungicides and biostimulants partially pathogenic.

The use of biological plant protection products and biostimulants containing microorganisms such as *Trichoderma* is considered a promising approach to reducing the use of chemical plant protection products in agriculture. However, our investigations in the „Tricho-Maize“ project show that this benefit must be viewed in a differentiated manner: Of twelve tested bioproducts based on *Trichoderma* strains, three showed moderate to severe cob infestation by *T. afroharzianum*. The infestation was particularly critical in one product containing the *Trichoderma asper-*

*ellum* strain, which until recently was approved as a biological fungicide in maize. Although this product has already been withdrawn from the German market, it shows that even organic products can pose a phytopathogenic risk. It remains unclear whether *Trichoderma* strains from organic plant protection products are capable of infecting and damaging maize after application.

### Significance for agricultural practice

The results highlight the growing relevance of *T. afroharzianum* for agricultural practice – particularly with regard to the increasing use of biological plant protection products. Since individual biostimulants and biological plant protection products may themselves contain pathogenic *Trichoderma* strains, there is considerable uncertainty surrounding the use of such preparations. Careful examination of ingredients, approvals and origin is therefore advisable. New challenges arise for consulting, plant health and, in particular, the breeding of resistant varieties, as it is difficult to distinguish them from other pathogens and hardly any resistant varieties are available.

### Conclusion

Currently, no biological plant protection products containing *Trichoderma* strains are approved for use on maize in Germany. Biostimulants, on the other hand, do not require approval and can continue to be used unchecked on a wide range of crops. Experiments show that some fungal strains from biological preparations can cause ear rot under laboratory conditions. Whether this also happens in normal field cultivation has not yet been proven. *Trichoderma* preparations should not be applied in close proximity to sensitive crops such as maize during flowering in order to prevent possible infestation.

If *Trichoderma* infestation is suspected, suspicious cobs should be harvested separately immediately to prevent further spread. A reliable diagnosis can only be made in the laboratory, as *Trichoderma* infestation can easily be confused with other conditions based on external appearance. Samples in the form of potentially infected cobs can be packed in paper bags and sent for analysis to the University of Göttingen, Department of Plant Pathology and Plant Protection, Grisebachstraße 6, 37075 Göttingen. Contact details and the location of the sampling should be included.

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### THE „TRICHO-MAIS“ PROJECT

The aim of the research project is to conduct Europe-wide monitoring to record the occurrence of *Trichoderma* species on maize cobs and to determine the harmful effects on maize, in particular the possible reduction in yield and quality.

More about the project:

