MIELIE KOPVROTSIEKTES VAN BELANG

Ekonomiesbelangrikekopvrotsiektesvan mielies word veroorsaak deur Stenocarpella maydis (Diplodia kopvrot), F. graminearum (Gibberella kopvrot) spesies kompleks en F. verticillioides (Fusarium kopvrot). In hierdie inligtingsgids beoog ons om inligting te verskaf oor die drie ekonomiese belangrike kop-vrotsiektes.

Diplodia kopvrot

Ekonomiese belangrikheid

Diplodia kopvrot in mielies word deur die swam Stenocarpella maydis (voorheen bekend as Diplodia maydis) veroorsaak. Diplodia is 'n siekte wat herhalend kan voorkom (epidemie) en geïnfekteerde graan word dan saam met nie-geïnfekteerde graan ge-oes wat dan die graan kwaliteit verlaag. Dit kan ernstige finansiële gevolge vir boere inhou in 'n seisoen wanneer die prys van mieliegraan relatief laag is. Graan wat met hierdie swam besmet is, bevat 'n gifstof wat skadelik kan wees vir beeste, skape en pluimvee. Beeste en skape word verlam en kan doodgaan as gevolg van diplodiose. Dragtige ooie wat van Diplodia besmette graan vreet, se lammers kan verlam wees of doodgebore word sonder dat kliniese tekens van diplodiose by die ooi self gesien word. Die voorkoms van die gifstof was vir lank uniek aan Suid-Afrika, maar onlangse verslae vanuit Argentinia en Amerika toon dat mikotoksikose as gevolg van die swam wyer voorkom. Navorsing word tans deur die LNR se Onderstepoort-InstituutvirVeeartsenykunde(OVI) in samewerking met die Instituut vir Graangewasse (IGG) gedoen om die aard van die gifstof vas te stel, sodat die presiese omvang van die gevaar vir diere bepaal kan word.

Voorkoms en verspreiding

Epidemies kom gewoonlik voor waar vroeë-seisoen droogtes, gevolg deur laat-seisoen reënval, en hoë vlakke van inokulum bo-op die grond voorkom. Die swam oorleef op mieliestoppels en die vrugliggaampies produseer spore met lente reëns wat dan die plante besmet. Die vrugliggaampies laat spore in die lug vry onder nat, vogtige toestande. Spore val op die plante en besmet koppe agter die kopblaar. Die swam groei dan deur die kop van onder na bo.

Simptome

Vroeë simptome in die ontwikkeling van die plant is vergeling en verdroging van geïnfekteerde mieliekop-skutblare. Die verrotting begin gewoonlik by die basis van die kop en versprei deur die kop (Figuur 1). Die mieliekop word deurtrek met 'n wit swamgroei (Figuur 2). In 'n besmette mieliekop wat oopgebreek word, sal swart spoorvormende strukture duidelik in die stronkweefsel waargeneem word (Figuur 3). Laat infeksies wat voorkom wanneer die pit-voginhoud laag is, is gewoonlik simptoomloos. As die kop oopgebreek word, kan daar 'n ligte verkleuring op die saadembrio voorkom en dit staan bekend as "skelm diplodia".

Beheermaatreëls

Kultivarkeuse

Geen kultivar is immuun teen diplodia-kopvrot nie, maar hul vatbaarheid verskil baie. Objektiewe kultivarkeuses kan uit resultate van die LNR-IGG se kultivar proefdata gemaak word.

Chemiese beheer

Die gebruik van swamdoders vir die beheer van diplodia-kopvrot in kommersiële mielie-aanplantings kan nie ekonomies geregverdig word nie.

Wisselbou

Wisselbou met gewasse soos sojabone, grondbone, koring en droëbone sal die diplodia-inokulum vlakke verminder wat sal help om die voorkoms van kopvrot by mielies te verminder. Deur mieliestoppels op die bo-grond te verminder word die bron van diplodia-swamspore verklein.

Ploeg

Die inploeg van besmette stoppels lei tot die vinnige afbreking van die stoppels deur swamme en bakterieë in die grond. Tydens 'n epidemie sal dit die boer loon om so vroeg moontlik te oes, want solank die mielies op die land staan kan verrotting vererger.

Fusarium graminearum (Gibberella) -kopvrot van mielies

Ekonomiese belangrikheid

Gibberella kop- en stamvrot kom wydverspreid in die mielieproduksiegebiede van Suid-Afrika voor. Hierdie siektes word veroorsaak deur vyf van die 16 swamspesies wat aan die Fusarium graminearum spesies kompleks behoort. Uit huidige studies by die LNR-Instituut vir Graangewasse, Universiteit van die Vrystaat en Stellenbosch Universiteit, wil dit voorkom asof Gibberella-kopvrot van mielies slegs deur F. boothii veroorsaak word. Die ander vier spesies kom in die wortel-, kroon- en stamvrotkompleks voor saam met F. boothii. Die F. graminearum spesies kompleks het verskillende gewas-gashere en weefsel-tipes wat onder die plante is wat in die grasfamilie val. Vatbare gewasse sluit mielies, sorghum, ko-ring, hawer, rog en gars in. Gibberella-kopvrot kom voor in mielies gedurende warm en nat weerstoestande (vanaf blom tot drie weke na baardstoot). Dit is in die periode wat die inokulum die kop deur die baard besmet. Gibberella-kopvrot is dus meer algemeen onder besproeiingstoestande. Die siekte kom meer gereeld voor in die matige oos-telike produksiegebiede, maar onlangs was daar 'n toename in die westelike produksiegebiede. Wisselbou van mie-lies met ander grasgewasse kan die siekte laat toeneem in die veld, afhangende van die hoeveelheid F. boothii inokulum wat oorgedra word van een seisoen na 'n ander. Dié siekte kan ook toeneem in lande waar min- of geen bewer-kingspraktyke toegepas word a.g.v. die stoppels wat agterbly. Gibberella-kop-vrot veroorsaak oesverliese en affekteer ook graankwaliteit. Swamme in die F. graminearum spesies kompleks kan mikotoksiene produseer soos deoxy-nivalenol (DON), nivalenol (NIV) en die estrogeen metaboliet, zearalenone (ZEA) wat ook die gesondheid van mens en dier kan aantas.

Voorkoms en verspreiding

Die oorspronklike bron van inokulum is vatbare graanreste, waarop die swam oorwinter het. Die swam vorm strukture op die stoppels wat dan spore vorm en vrylaat. Hierdie spore word in die lug deur die wind versprei. Spore land op die baard van die kop of agter die blaarskede of infekteer wortels en/of die plant se kroon, waar infeksie plaasvind. Die swam groei dan in die verskillende weefsels in en veroorsaak 'n reeks siektes (kopvrot, stamvrot, kroon- en wortelvrot van mielies).

Simptome

Kopvrotsimptome is 'n gedeeltelike of algehele donkerrooi verkleuring (Figuur 4) van die mieliekop. Vroeë infeksies kan lei tot verrotting van die hele kop met miselium, wat die kopblare aan die kop vashou. Gibberella-kopvrot infeksies begin aan die voorpunt van die mieliekop (Figuur 5) en die swam groei terug na die plant toe. Graan wat met F. boothii besmet is, word weens vrot pitte (Figuur 6) afgegradeer. Besmette pitte kan op hul beurt ernstige gevolge hê vanweë die produksie van mikotoksiene. Die F. graminearum spesies kompleks kan ook stamvrot tot gevolg hê en simptome is die afbreek van stamweefsel en 'n rooi verkleuring – veral op die nodes van die kroon en stam. Die swam breek die weefsel-struktuur binne die stam af sodat die plant nie meer regop kan staan nie en dan omval.

Beheermaatreëls

Wisselbou

Die kies van alternatiewe gewasse in 'n wisselboustelsel is baie belangrik. Vermy wisselbou met grasagtige gashere wat vatbaar is vir die F. graminearum spesies kompleks van swamme. Wisselbou is veral belangrik waar minimum of geen bewerkingspraktyke toegepas word. Wisselbou ontneem die swam van 'n gasheer en verminder inokulum deur die vermindering van geïnfekteerde stoppel.

Stoppelvermindering

Enige praktyk wat stoppel verminder, sal ook die primêre inokulumbron verminder. Spore oorwinter op mielie- of koringreste, en sal dan nuwe plante in die groeiseisoen besmet. Hoe meer primêre inokulum, hoe groter die risiko vir besmetting. Al is inokulumvlakke hoog, en die klimaat is nie reg nie, sal daar geen infeksies plaasvind nie. Die klem is hier op vermindering van besmette reste deur weiding, ploeg of in uiterste gevalle brand. Waar minimum of geen bewerking die gebruik is, moet boere alternatiewe beheermaatreëls gebruik. Dit is dus hier waar wisselbou as deel van 'n geïntegreerde plaagbeheerstelsel noodsaaklik is.

Kultivarkeuse (weerstand)

Kultivars verskil in terme van weerstand of vatbaarheid teen Gibberella kop- en stamvrot. Weerstand teen die kopvrotfase van die siekte, waarborg nie weerstand teen stamvrot nie. Daar is tot dusver nie voldoende data beskikbaar aangaande weerstandbiedende kultivars nie, alhoewel baie vatbare kultivars al geïdentifiseer is. Inligting moet ingewin word by saadmaatskappye oor kultivarkeuses.

Fusarium verticillioides kopvrot van mielies

Ekonomiese belangrikheid

F. verticillioides is 'n ekonomiese belangrike kopvrot en lei jaarliks tot verliese as gevolg van laer opbrengste en swak graangradering. Hierdie swam beskik die vermoë om 'n toksien genaamd fumonisien te produseer en handelaars dra dikwels die onkoste om graan daarvoor te toets. Hierdie fumonisiene word as 'Groep 2B karsinogene ' geklassifiseer wat beteken dat dit kankervormend in mense kan wees. In Suid-Afrika word graangradering in kommersiële mielieproduksie gebruik om vir mens en dier die risiko van swambesmette graan en gevolglik swak graan wat moontlik met mikotoksiene besmet is, te verminder. Bestaansboere, wie se graan nie gegradeer word nie, is veral blootgestel aan die gevare van besmette graan en fumonisien deur 'n tekort aan kennis daarvan en die langdurige blootstelling aan fumonisien in hulle dieet.

Voorkoms en verspreiding

F. verticillioides word orals in Suid-Afrika aangetref, veral in droë, warm gebiede met temperature bo 28 °C. Stremmingsfaktore soos droogte, insek – en voëlskade sal die voorkoms van die swam aanhelp. Mielieplante kan op verskeie groeistadia geïnfekteer word, maar is veral vatbaar vir kopvrotinfeksies tydens die blomstadium. Die swam kan in die grond of stoppel oorwinter, waar dit die plant gedurende die groeiseisoen kan infekteer, deur spore, as toestande gunstig is. Reën en wind kan ook spore op die mielieplant se baard laat beland en so vind infeksie van die kop plaas.

Simptome

Bekende simptome is 'n wit-pienk swamgroei op pitte langs stamboordervreetkanale (Figuur 7). Soortgelyke simptome word ook met insek- en voëlvreetskade op mieliekoppe geassosieer. Onbeskadigde pitte kan ook 'n pienk verkleuring toon en sulke besmettings vind gewoonlik deur die baard plaas (Figuur 8). Die swam besmet ook koppe en pitte sonder enige sigbare simptome. In so 'n geval is die produsent onbewus van die swam en die moontlike teenwoordigheid van fumonisiene.

Beheermaatreëls

Kultivarkeuse

Geen kultivar beskik volle weerstand teen F. verticillioides infeksie en fumonisienproduksie nie. As gevolg van verskeie faktore is dit moeilik om kultivars vir stabiele weerstand te evalueer met konvensionele evaluasie tegnieke en daarom speel die regte bestuurspraktyke tans 'n belangrike rol in die beheer van F. verticillioides kopvrot en gevolglik fumonisien produksie.

Produksiepraktyke

Gesamentlike navorsing, deur Stellenbosch Universiteit en die LNR-Instituut vir Graangewasse, kyk na verskeie weerstands-aspekte vir die identifisering van moontlike weerstandbiedende kultivars. Navorsing om die rol van Bt-mielies wat stamboorder infestasies beperk, kan moontlik ook lei tot laer F. verticillioides infeksie en fumonisien produksie. Vermyding van stremmingstoestande en skade aan plante gedurende bewerkings en tydens oestyd, en die berg van graan in 'n skoon droë area om kontaminasie en verspreiding van die swam te beperk, behoort infeksie en fumonisiene in toom te hou.

Fig 1. Diplodia verrotting begin by die basis van die mieliekop.
Diplodia infection starting at the base of the maize ear.

Fig 2. Mieliekop oortrek met wit swamgroei.
White mycelial growth on the maize ear.

Fig 3. Swart spoorvormende strukture in die stronkweefsel.
Black spore producing bodies at kernel base.

Fig 4. Gibberella-kopvrot veroorsaak 'n donker-rooi verkleuring van die mieliekop.
Red discolouration of the maize ear.

Fig 5. Gibberella-kopvrot begin aan die voorkant van die mieliekop.
Gibberella ear rot progress from the tip of the ear downward.

Fig 6. Gibberella-besmette graan.
Gibberella infected grain.

Fig 7. Witpienk F. verticillioides swamgroei langs stamboordervreetkanale.
White-pink F. verticillioides mould on kernels alongside stalk borer channels.

Fig 8. Pienk verkleuring van onbeskadigde pitte veroosaak deur F. verticillioides.
Pink discolouration of undamaged kernels.

IMPORTANT MAIZE EAR-ROT DISEASES

Economically important maize ear-rot disease are caused by Stenocarpella maydis (Diplodia ear rot), F. graminearum (Gibberella ear rot) species complex and F. verticillioides (Fusarium ear rot). With this maize information guide, we aim to give information regarding these economically important ear rot diseases.

Diplodia ear-rot

Economic importance

Diplodia ear rot of maize is caused by the fungus Stenocarpella maydis (previously known as Diplodia maydis). Diplodia ear rot can re-occur (epidemic) in certain areas and infected grain is then harvested with the healthy grain, thereby reducing grain quality. Reduced grain quality will have negative financial implications as this reduces the price the producer receives for his grain. During such an epidemic when early infections are present, yield losses can be of great economic importance. Harvested fields infected with diplodia can be harmful to grazing animals because the fungus produces a poison (toxin) which can be ingested by farm animals. Cattle, sheep and poultry are particularly vulnerable to this/these toxin/s which result in paralysis and death. When a pregnant ewe ingests contaminated diplodia grain or maize stubble, her unborn lamb can be paralysed or even die although the ewe does not show any visible symptoms of diplodiosis. This toxin was unique to South Africa for a long time but recent reports of diplodiosis in Argentina and the USA have shown this mycotoxicosis to be more widespread than originally thought. Collaborative research done by ARC-Grain Crops Institute and the ARC-Onderstepoort-VeterinaryInstitute (OVI) aim to isolate and understand this toxin better and to determine the potential threat to animals.

Incidence and spread

Drought in the early season followed by late season rain can lead to diplodia epidemics, especially where high inoculum sources are present on stubble on the soil. This fungus has the ability to produce spore producing structures that can survive on maize stubble through the winter and produce spores during spring which then infect plants during the growing season. After rain or high humidity, these structures release spores in the air, which land on maize plants and infect the base of the ear/leaf junction and ramifies upwards into the ear.

Symptoms

Diplodia ear-rot symptoms associated with infections during early ear development are yellowing and drying of husk leaves. Infections starts at the base of the ear and ramifies upwards (Figure 1). The entire ear becomes overgrown with a white mycelial growth (Figure 2). A cross section of an infected ear shows black spore-producing bodies at the kernel bases (Figure 3). Late season infections may occur when kernel moisture is low and symptoms are less obvious. Such asymptomatic infections are locally referred to as "skelm Diplodia".

Control measures

Hybrid resistance

There are no hybrids on the market that are immune to Diplodia ear-rot. Hybrids with a degree of resistance to Diplodia can be selected from the ARC-GCI cultivar evaluation trials.

Chemical control

The use of fungicides for the control of diplodia ear-rot in commercial maize production can not be economically justified and efficacy is limited.

Crop rotation

Crop rotation with soybeans, groundnuts, wheat and drybeans reduce diplodia-inoculum levels which in turn reduce diplodia ear-rot infections. Firstly a non-host for the fungus will not allow the fungus to persist for the season where maize is not grown. Secondly a greater period (two or more seasons) between maize crops allows for natural breakdown of maze stubble, which again reduces the survival of the fungus. It is advisable to harvest earlier during a diplodia epidemic to stop rotting of the maize plants in the field.

Tillage

Practices which reduce surface stubble retension will reduce initial inoculum sources, however, this must be used judiciously together with other control measures when epidemics occur.

Fusarium graminearum (Gibberella) maize ear-rot

Economic importance

Gibberella ear and stalk-rot are found throughout the maize production areas of South Africa. Maize ear and stalk-rots are associated with five of the 16 fungal species present in the Fusarium graminearum species complex. Collaborative studies with the ARC-Grain Crops Institute, Free State University and Stellenbosch University, show that Gibberella ear-rot of maize are caused only by F. boothii. The other four species, together with F. boothii, have been isolated from maize roots, crowns and stems. A large number of cereals are affected by the F. graminearum complex including maize, sorghum, wheat, barley and rye. Gibberella ear-rot of maize occurs during warm and wet weather conditions (from flowering up to three weeks after tasseling). During this stage the inoculum infects the maize ear via the silks. Gibberella ear-rot is more prevalent under irrigation in the eastern maize production areas, but have increased recently in the western maize production areas. Crop rotation with cereals can increase Gibberella ear-rot in the field depending on the amount of inoculum present that is carried over from one season to another. Maize stubble due to reduced or no tillage practices can increase the amount of inoculum and Gibberella ear-rot infections from one season to another. Gibberella ear-rot can negatively influence yield and grain quality. Fungi in the F. graminearum species complex kan produce mycotoxins such as deoxynivalenol (DON), nivalenol (NIV) and the estrogen metabolite, zearalenone (ZEA) which is detrimental to human and animal health.

Incidence and spread

The inoculum source comes from maize and other cereal residues in the soil on which the fungi overwinters in special structures. In the new growing season, spores are disseminated in the air by means of wind, rain or insects. Spores land on maize silks, behind leaf sheaths, or even roots and crowns. When the fungi infect the maize tissue symptoms can be seen on the ear, stem, crown or root of the maize plant.

Symptoms

Symptoms are dark, red discolouration of the whole or part of the maize ear (Figure 4). Early infections result in complete ear rotting, with husks adhering tightly to the ear. Gibberella ear-rot usually progresses from the tip of the ear downward (Figure 5). Gibberella infected grain (Figure 6) can be downgraded or rejected. The major concern is the mycotoxicoses associated with this disease. The F. graminearum species complex can also cause stalk rot and typical symptoms include red discolouration on the nodes of the stalk and the crown. The fungus disintegrates the internal structure of the stalk resulting in lodging.

Control measures

Crop rotation

The rotation of maize with non-graminaceous crops decreases the incidence of Gibberella ear-rot. Rotation is extremely important with minimum or no tillage practices to reduce inoculum by planting a non-host for the fungus and also to allow the stubble to break down which reduces the survival of the fungus.

Stubble removal

As the fungus overwinters on maize stubble retained on the soil surface, the removal of crop residues will reduce disease incidence in the following crop season. This fungus is a facultative pathogen and can survive on a wide variety of residues and organic material in or on the soil. Any farming practices (grazing, ploughing) that will reduce surface residue levels will reduce the survival of the fungus in the stubble. When using minimum or no tillage practices, producers should use alternative control measures such as crop rotation.

Hybrid resistance

Hybrids vary in susceptibility to the disease. Hybrids with a degree of resistance to Gibberella maize ear-rot may not have the same degree of resistance to Gibberella maize stalk-rot due to the different fungi involved in the disease complex. Please obtain information from seed companies regarding cultivar selections as field observations will give a good indication of some resistance in a cultivar adapted to specific areas.

Fusarium verticillioides ear-rot of maize

Economic importance

F. verticillioides can cause ear, root and stalk rot of maize and can lead to economic losses due to yield loss and grain quality reduction. F. verticillioides has the ability to produce the mycotoxin fumonisin and merchants often pay to test grain for these toxins. The potential carcinogenic risk of fumonisin B_1 to humans was evaluated and classified by the World Health Organizations International Agency for Research on Cancer (WHO-IARC) as "Group 2B carcinogens" which means they are probably carcinogenic to humans. Grain grading systems in South Africa reduce the risk of contaminated grain reaching the food chain of humans and animals. It is however, subsistance farmers that are mainly at risk of consuming contaminated grain (due to a lack of information and knowledge) over a long period of time.

Incidence and spread

F. verticillioides can be found throughout South-Africa and grows well at temperatures above 28°C. F. verticillioides has a saprophytic as well as pathogenic stage and may infect maize at all sta-ges of plant development, either via the silk channel, infected seed, or wounds. F. verticillioides can be transmitted to uninfected plants by inoculum from field stubble or airborne conidia (micro- and macroconidia) which are abundant in maize fields during a growing season. The most commonly reported method of kernel infection is through airborne or water-splashed conidia that land on the silks.

Symptoms

One symptom type noted in the field is the growth of white-pink cottony mould on kernels alongside stalk borer channels (Figure 7). Similar symptoms are often associated with other insect or bird damage on ears. Another symptom type is a pink discolouration of undamaged kernels (Figuur 8). The fungi can also infect the maize ear without showing any symptoms and the producer is unaware of the fungal infection and possible fumonisin contamination.

Control measures

Hybrid resistance

The responses of cultivars tested by the ARC-CGI to date for F. verticillioides infection over localities and seasons, is inconsistent. Emphasis therefore, needs to shift to management strategies in the field to ensure the quality and safety of maize food and products. This is complicated by the complexity of interactions between numerous abiotic and biotic factors, our need to understand them, and their manipulation to prevent or reduce the growth of F. verticillioides and thereby reducing contamination by fumonisins. Collaboration between ARC-GCI, Free State University and Stellenbosch University has identified and screened maize genotypes for resistance to both F. verticillioides and fumonisins.

Production practices

Research regarding the reduction of insect damage on Bt maize stalks to reduce infection by Fusarium spp. through plant injuries and subsequently reducing fumonisin levels are being conducted at the ARC-GCI. Birds that cause physical injury to stalks and ears are also suspected to promote infection by Fusarium spp. The most plausible solution seems to be prevention in the field through crop techniques that are able to guarantee less favourable conditions for F. verticillioides development and subsequent fumonisin production. Cropping practices such as N fertilization, timing of sowing and harvesting, insect control and plant density influence fumonisin contamination in maize grains.