Department
for Environment
Food & Rural Affairs

Plant Pest Factsheet

Emerging Pests of maize

Date: November 2022

Version: 3

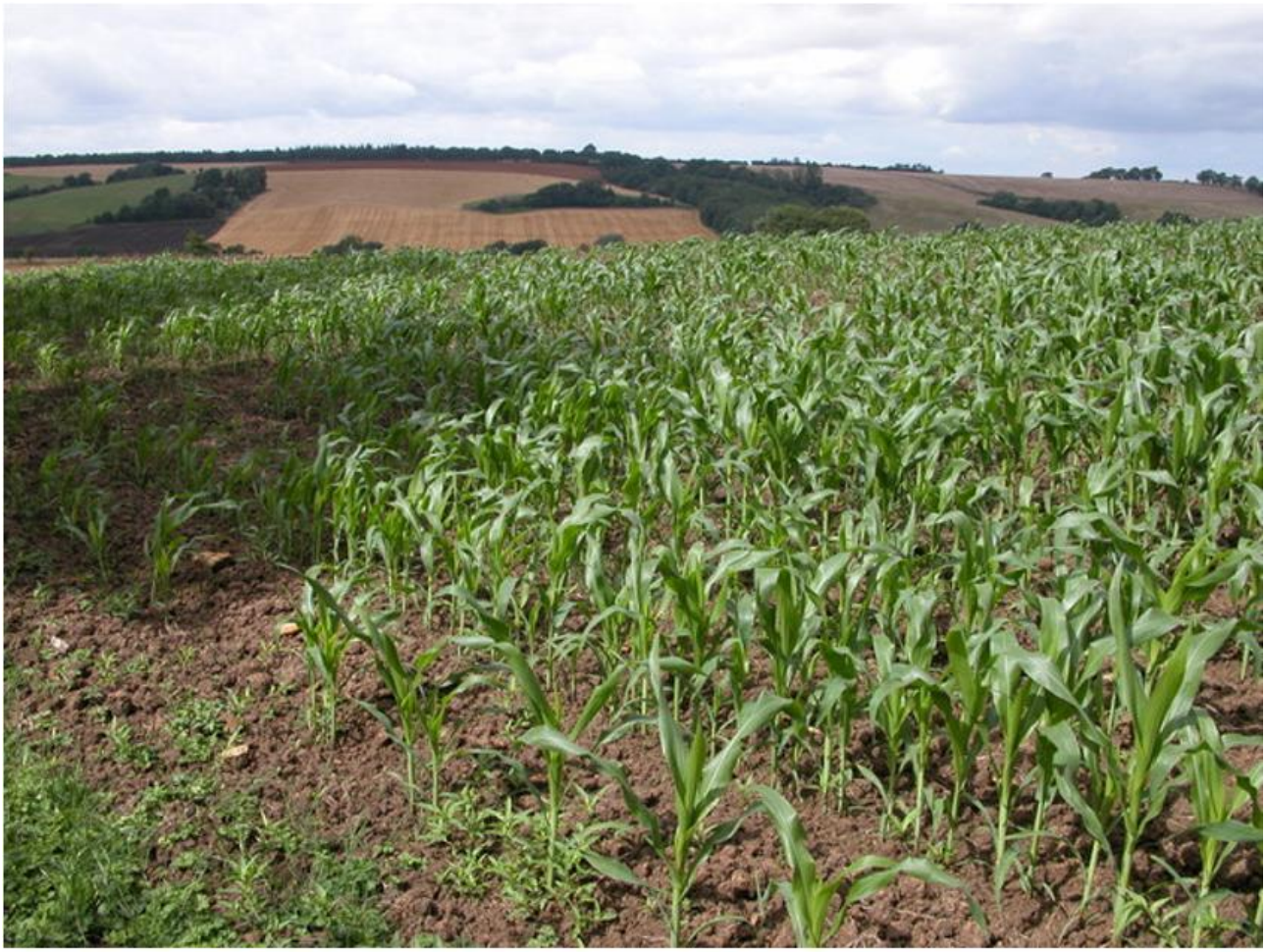

Figure 1. Maize crop near Coombe Farm, Long Compton. © Philip Halling, geography.org.uk

Contents

Notifiable pests

1. Tar spot complex 3

2. Stewart's bacterial wilt 4

3. Fall armyworm 5

4. Lesser corn stalk borer 6

Non notifiable pests

5. Western corn rootworm 6

6. Dry rot and leaf spot of maize 7

7. Eye spot 8

8. Tobacco stunt nematode 9

9. European & Asian corn borer 10

Background

There are a number of pest and disease organisms that are not present or not widely established in the UK and present a risk to maize crops. This factsheet provides summary information for growers on some of the most important emerging or potential threats to UK maize (*Zea mays*) production, for grower's awareness and to aid in the recognition of some of these pests.

Notifiable pests

1. Tar spot complex

Two different fungal species *Phyllachora maydis* and *Microdochium maydis* (which is also called *Monographella maydis*) individually cause minor symptoms on maize. When both species invade a host together, however, they cause 'tar spot complex', a highly damaging disease. Symptoms start with small black spots appearing on the leaves, which are an early sign to look out for (Fig. 2). These spots are caused by *Pyllachora maydis*, and are subsequently colonised by *Microdochium maydis*, resulting in the formation of characteristic 'fish eye' lesions (Fig. 2). These lesions spread across the plant quickly, and a host can be completely blighted within 8 to 14 days after initial infection. Infected ears are lighter, with loose kernels that are not fully filled, and some show premature germination while still on the cob (Fig. 2).

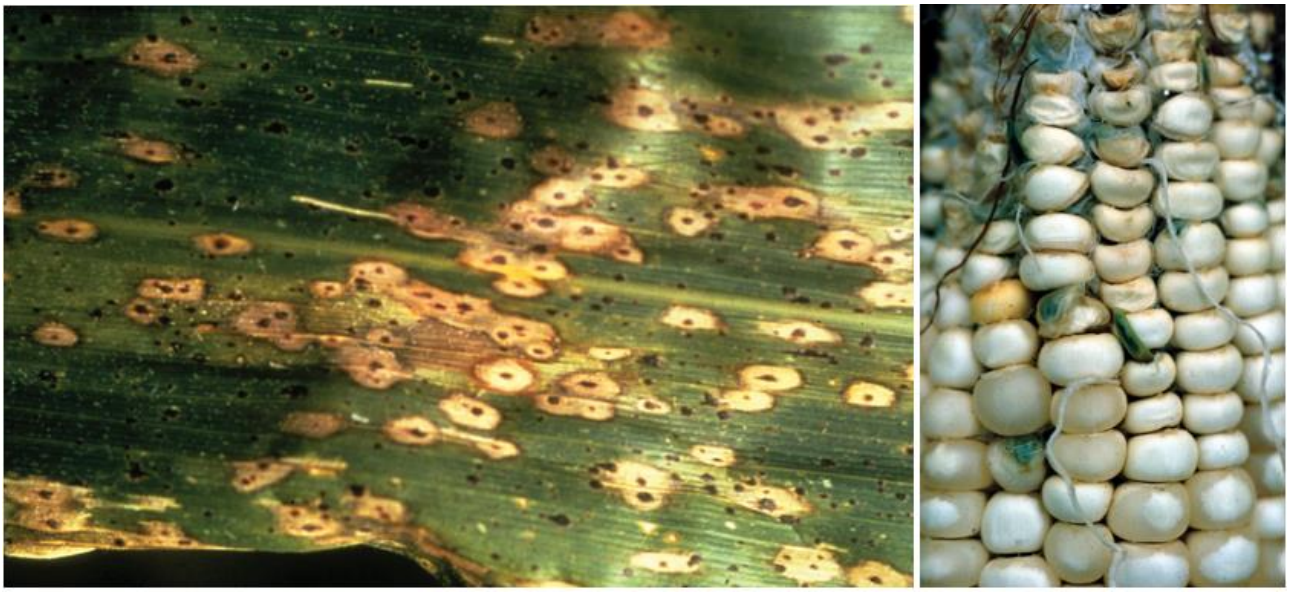

Figure 2. Tar spot complex of maize caused by a combination of *Phyllachora maydis* and *Microdochium maydis*. 'Fisheye' lesions (left) on maize leaves spread rapidly across leaves with widespread necrosis after infection with both *P. maydis* and *M. maydis*. Maize ears (right) infected with tar spot complex © CIMMYT.

Tar spot complex is causing very significant yield losses in Central and South America, with some regions in Mexico suffering up to 70-90% losses.

Both species are found across Central and South America. One of the two causative species, *Phyllachora maydis*, has also been found in the USA where it is causing minor damage. In 2019, *P. maydis* was detected for the first time in the UK on imported maize cobs in a sweetcorn processing facility. As the two species together have the potential to cause significant crop losses, the presence of either one should be reported to the plant health authorities.

2. Stewart's bacterial wilt

Pantoea stewartii subsp. *stewartii* (Stewart's bacterial wilt) is a bacterium indigenous to the Americas. It has been introduced to other parts of the world via maize seeds. It is known to cause the bacterial diseases Stewart's wilt and leaf blight. This disease primarily effects *Zea mays*, especially sweet corn, but dent, flint, flour and popcorn cultivars can also be infected. It has also been recorded on other cereal crops such as rice, millet and sorghum.

In the bacterium's native range (the Americas) it is transmitted by the corn flea beetle (*Chaetocnema pulicaria*) via feeding. It is the only known efficient vector and is the main overwintering site of the bacterium. *Chaetocnema pulicaria* is not present in the UK and, with the exception of *Delia platura* (seedcorn maggot), there are no other known vectors in the UK.

As the primary vector is absent from the UK the main route for the bacterium to infect a stand is via infected seed or plants for planting, and there is also some evidence that the bacterium can overwinter in soil, manure or maize stalks. The bacterium may be found on/in seeds of maize, but no characteristic symptoms are visible on infected seeds.

The first detectable phase of the disease, which can affect the plants at the seedling stage, is wilting. The bacterium spreads completely through the plants vascular system. If the plant is infected during a late growth stage, plants can reach a reasonable size. The leaves develop pale-green to yellow streaks up the veins, and these can extend up the whole length of the leaf, with the streaks having an irregular/wavy edge (Fig 3). Over the growing season these streaks dry out and turn brown. The corn husks can develop small water soaked spots. The bacterium may also cause oozing of yellowish droplets on the inside of the husk.

Plants that do survive can end up producing dead, bleached tassels. In extreme cases cavities can be found close to the soil in the stalk pith of infected plants (Fig 3).

The bacterium is able to penetrate into the seed through wounds as well as through the xylem. This causes an infection under the seed coating but it does not enter the seed embryo.

Figure 3. Leaf streak (left) caused by *Pantoea stewartia* subsp. *stewartii*. © J. K. Pataky, University of Illinois at Urbana-Champaign, Bugwood.org. Stalk pith cavities (right) caused by *P. stewartia* subsp *stewartii*. © Department of Plant Pathology, North Carolina State University, Bugwood.org

3. Fall armyworm

The fall armyworm, *Spodoptera frugiperda*, is a noctuid moth originating from the tropical and subtropical regions of the Americas. It is extremely polyphagous and feeds on a very wide range of plants, predominantly grasses and cereal crops especially maize where yield losses can be between 13 and 30%. It causes significant damage to field crops and has been recorded feeding on more than 80 additional crop species. In 2016 it was accidentally introduced to Africa and has subsequently spread via trade across the continent and into Asia where it was detected in 2018. In 2017 the UK started to intercept the larvae in fresh produce coming into the UK from Africa.

The larvae are highly damaging to stands of crops and are known for massing in large numbers and stripping whole fields of crops before moving on to the next one, hence the name “army worm”. The caterpillars can completely defoliate plants, but stems, buds, flowers and fruit can also be damaged. Young larvae feed on all growth stages of maize but most frequently in the whorl of young plants. Older larvae begin to make holes in the leaf and stem and can completely destroy small plants as well as strip larger ones. The caterpillars then pupate and form a loose cocoon up to 2 cm long just under the surface of the soil close to the host plant.

With ideal climatic conditions and the abundance of suitable host plants the fall armyworm can produce several generations in a single season, and in its native range the fall army worm is able to migrate from subtropical America to temperate regions of north and south America over the course of a summer, with larvae being found in autumn in North America giving rise to the name “fall” army worm. The larvae are unable to survive the cold winters of northern latitudes, so do not overwinter outside of the tropics and sub tropics. The adults are very strong fliers and disperse easily on the wind. There is a very real threat that if this species became established in southern Europe it could migrate to northern Europe over a summer season.

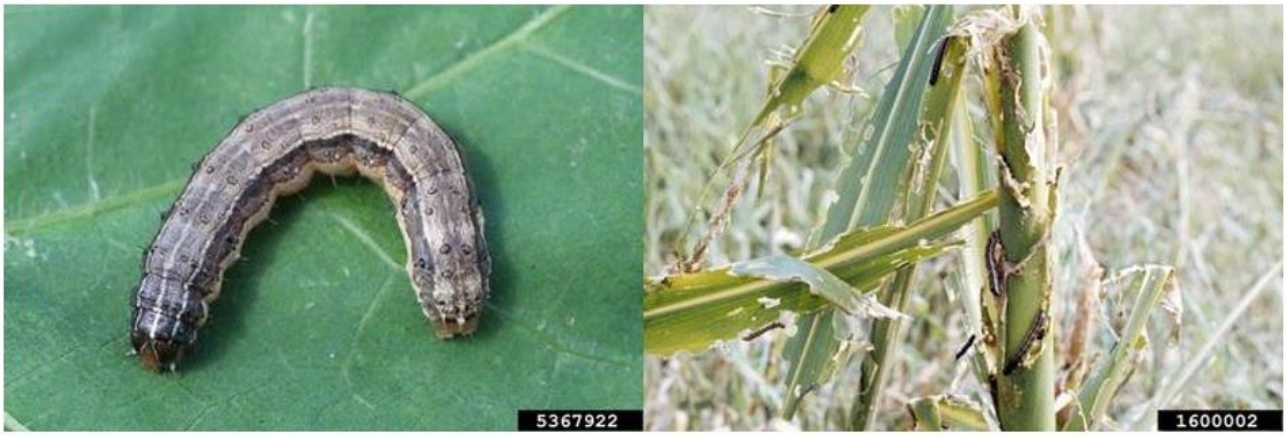

Figure 4. Fall army worm (*Spodoptera frugiperda*). Larva (left) of *S. frugiperda* © Russ Ottens, University of Georgia, Bugwood.org. *S. frugiperda* larvae (right) feeding on *Zea mays* © John C. French Sr., Retired, Universities: Auburn, GA, Clemson, and U of MO, Bugwood.org.

This is a notifiable pest so it is important that its presence should be reported to the plant health authorities. Currently the fall army worm is not present in the UK and there have been no findings of the larvae in the wider environment, and no reports of damage. Any findings of this species in the UK would be of significance. If this moth was to establish here, we could expect to see very significant losses not just in maize but also in other crops.

4. Lesser corn stalk borer

Lesser corn stalk borer (*Elasmopalpus lignosellus*) is a species of snout moth (Pyralidae). It is a polyphagous pest, primarily of grasses, but it is also known to feed on a wide range of other hosts. These hosts are usually “weed” species alongside crops. Native to the Americas, this moth is found from South and Central America to the southern United States. In 2019 the UK started to intercept the larvae in fresh produce. In its home range it is a pest of several economically important crops including maize.

The larvae (Fig 5) damage plants when feeding upon, and tunnelling within, the stems. They live in the soil, within tunnels constructed from soil and silk. Larvae leave these tunnels to feed on the basal stalks of plants or just below the soil surface. As the larvae mature they migrate up through the plant stem. This leads to “dead heart” in the crop and, occasionally, girdling of the stem. The resulting damage can also facilitate secondary infection by pathogens. “Dead heart” and girdling often leads to the death of the plant. Maize plants that do not die as a result of larval damage are reported to produce several bushy and stunted suckers with no marketable ears.

The lesser corn stalk borer causes significant crop losses in the US and Central/South America, but it is not well suited to the colder UK climate and is unlikely to cause similar levels of damage here. The lesser cornstalk borer seems to be adapted for hot, arid conditions, and is more abundant and damaging following unusually hot, dry weather in its native range.

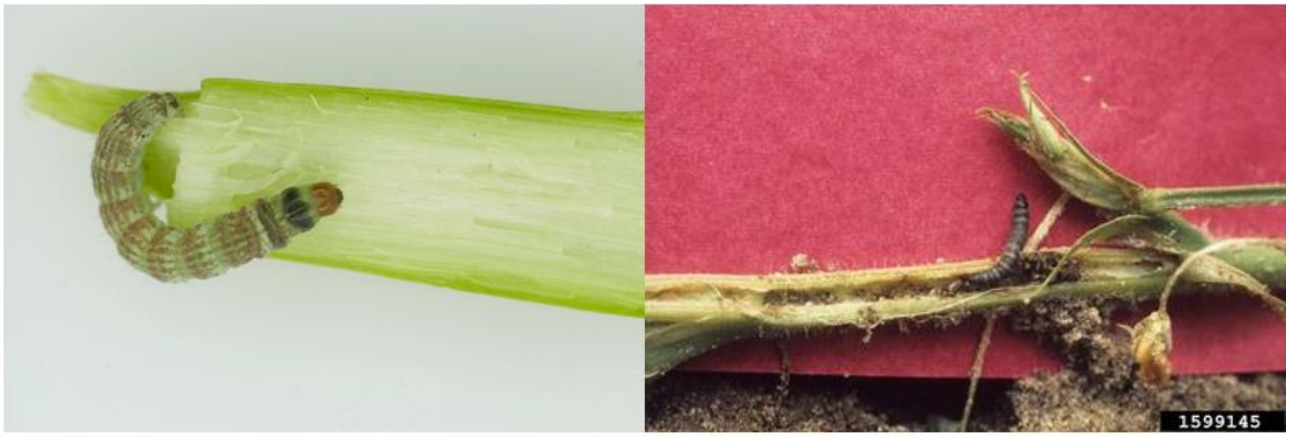

Figure 5. Lesser corn stalk borer (Elasmopalpus lignosellus). Larva (left) on asparagus © Fera Science Ltd. Larval tunnel (right) on peanut. © John C. French Sr., Retired, Universities: Auburn, GA, Clemson, and U of MO, Bugwood.org.

The lesser corn stalk borer causes significant crop losses in the US and Central/South America, but it is not well suited to the colder UK climate and is unlikely to cause similar levels of damage here. The lesser cornstalk borer seems to be adapted for hot, arid conditions, and is more abundant and damaging following unusually hot, dry weather in its native range.

Currently lesser corn stalk borer is not present in the UK and there have been no findings of the larvae in the wider environment, and no reports of damage. But has recently been intercepted in commodities entering the UK and Europe. Any findings of this species in the UK would be of significance. Although the damage from this species would be considered minor, it is important that the presence should be reported to the plant health authorities. If this moth was to establish here, we could expect to see losses not just in maize but also in other crops.

Currently lesser corn stalk borer is not present in the UK and there have been no findings of the larvae in the wider environment, and no reports of damage. But has recently been intercepted in commodities entering the UK and Europe. Any findings of this species in the UK would be of significance. Although the damage from this species would be considered minor, it is important that the presence should be reported to the plant health authorities. If this moth was to establish here, we could expect to see losses not just in maize but also in other crops.

Non notifiable pests

5. Western corn rootworm

The western corn rootworm, *Diabrotica virgifera* subsp. *virgifera*, is a North American beetle that has established in Europe. There have been several outbreaks of this pest in

the UK, with efforts to eradicate the pest taking place between 2003 and 2013. The pest was considered a quarantine pest in the EU until 2014.

The pest can be highly damaging. Larvae of the beetle (Fig. 6) feed on the roots, reducing nutrient uptake and growth, and sometimes resulting in lodging during severe infestations. Adults (Fig. 6) feeding on the leaves and silks also cause damage and can interfere with pollination and grain formation. The beetle causes significant crop losses in the US and central/eastern Europe, but the beetle is not well suited to the colder UK climate and is unlikely to cause similar levels of damage here.

Figure 6. The Western corn rootworm (*Diabrotica virgifera* subsp. *virgifera*). Larva (left) of *D. virgifera* © Scott Bauer, USDA Agricultural Research Service, Bugwood.org. Adult (right) of *D. virgifera* © U. Schmidt.

The beetle's current distribution in the UK is uncertain as there have been no findings of the beetle since 2013, and no reports of damage. It is no longer a listed pest and statutory action would not be taken against findings. In the UK the beetle is only likely to build up to economically damaging levels when maize is grown in a continuous cropping cycle. Because of this, crop rotation of at least two years before replanting maize, and restricting the maize grown in areas surrounding any finding, will be effective in managing this pest if found again.

6. Dry rot and leaf spot of maize

Two different fungal diseases of maize, dry rot (caused by *Stenocarpella macrospora*) and leaf spot (caused by *Stenocarpella maydis*), are both significant problems for maize growers in warmer climates. Estimations of losses due to these diseases vary between seasons and regions, but both are considered among the most destructive diseases of maize globally, with yield losses between 10 and 20% commonly found in the USA.

Having spread through the trade in maize seed, the fungi are now widespread in Asia, Africa, North and South America and Australia. Both species have been detected in the EU, but only leaf spot caused by *Stenocarpella maydis* has established in the EU, where it has been recorded in parts of Austria, Czechia and Italy. *Stenocarpella maydis* has never

been found on UK grown crops, but has been intercepted on imported maize. Industry surveillance for this pathogen is recommended, even if it is not yet clear how suitable the UK's climate would be for the establishment of this disease.

Both of these diseases can cause rot of the ear and stalks. Ear rot usually begins at the ear base, and can turn the entire ear greyish-brown and shrunken, with white mould found between the grains (Fig. 7). Stalk rot symptoms include 1-10 cm long brown lesions on the stalk and leaves, and wilting, discoloration and drying (Fig. 7). When seed is infected, high levels of pre-emergence death are seen, and seedlings that do emerge develop brown lesions with abnormal root development. Yield losses arise from both poor grain filling and crop loss due to lodging.

Figure 7. Symptoms of *Stenocarpella maydis* and *Stenocarpella macrospora* on maize. Ear rot (left) caused by *S. maydis*. Leaf stripe (centre) caused by *S. maydis* on maize. Stalk rot (right) caused by *S. macrospora* showing browning of the pith. © CIMMYT.

These species can produce toxins that are harmful to animals. If infected material is used as feed it can cause mycotoxicosis. There is no requirement to report the presence of these pathogens to plant health authorities, but it would be advisable to send samples of potentially infested crops for commercial testing.

Seed treatments are effective in controlling seedling blight, but if the fungus becomes established in the soil, crop rotation may be needed to eliminate it. Seed certification schemes may be effective in preventing the spread of the disease.

7. Eye spot

Kabatiella zeae is a fungal pest of maize which causes eye spot. Economic losses are uncommon, but yield can be affected when infection occurs very early in the season.

Infected crop debris from the previous season is the source of new infection of seedlings. Initial symptoms include small light-colored spots surrounded by a red-brown ring and a chlorotic yellow halo (Fig. 8). The spots gradually become darker and spread to cover wide areas of the leaf (Fig. 8). The spots can also be seen on the leaf sheath of the ears, where it can cause shriveling. Infected leaves eventually die, leading to a reduction in grain production.

The disease is found in many regions globally, in China, India, Japan, Argentina, Brazil and across much of North America and Europe. It has been found in the UK, but reports of economic damage are minimal. This pathogen is likely to have entered the UK on seeds. The full extent of its distribution and damage in the UK is unknown.

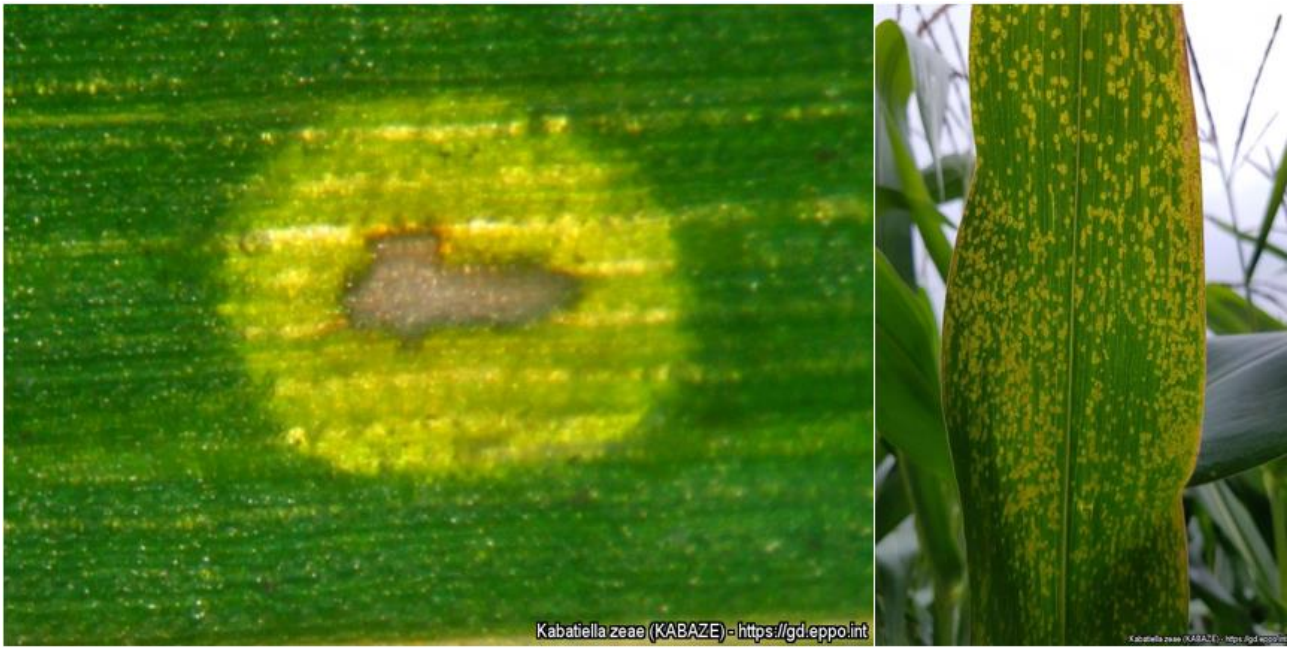

Figure 8. Symptoms of eye spot of maize caused by *Kabatiella zeae*. Early eye spot (left) on maize. Eye spot symptoms spreading (right) on a maize leaf. © EPPO Andreas Tillessen.

The disease is thought to be well managed through crop rotations, which prevent the build-up of inoculum in the soil, and through deep ploughing of crop debris. Fungicide seed treatments may reduce the risk associated with infected seed. Some foliar fungicide treatments are known to be effective, but may be prohibitively expensive and require multiple applications across the growing season. There is no requirement to report the presence of this pathogen to the plant health authorities.

8. Tobacco stunt nematode

The tobacco stunt nematode, *Tylenchorhynchus claytoni,* is widespread in Asia, North America and parts of Europe. The nematode feeds on roots and can cause stunted growth and development. The pest has a very wide host range including turf, potato, tobacco, wheat and azaleas, with additional reports of it feeding on maize.

In the UK, this nematode has been found at nurseries associated with azaleas and has been intercepted on imported plants several times but does not appear to have established in agricultural fields. It is not clear if this pest poses a significant risk to maize in the UK at present, but growers should maintain an awareness of it. Statutory action would not be taken on this pest if intercepted or found in the field.

9. European & Asian corn borer

European corn borer (*Ostrinia nubilalis*) is a species of grass moth (Crambidae). It is a polyphagous pest, primarily of grasses, but it is also known to feed on a wide range of other hosts, particularly maize. The non-grass hosts are often ruderal species found in field margins alongside commercial crops. This species has two races: the “E” race, with larvae that preferentially feed on *Artemisia* species, and the “Z” race, with larvae that preferentially feed on *Zea mays*. Both races are identical in appearance, but the female moths produce different ratios of pheromones. This moth is native to Europe and occurs across mainland Europe, parts of North Africa and into Asia, where it is reported as far as Indonesia. Reports of *O. nubilalis* in East Asia probably refer to the closely related species, *O. furnacalis* (Asian corn borer). The European corn borer has also been introduced into the United States on several occasions and is found right across North America from Texas to Canada. Present in the UK since the 1930’s this species was recorded feeding on *Artemisia vulgaris* (mugwort). In 2010 a grower in the South-West of England contacted the plant health authorities regarding caterpillars boring into stems of maize (*Zea mays*). The species was confirmed as *O. nubilalis* and was the first finding of *O. nubilalis* causing damage to a UK maize crop.

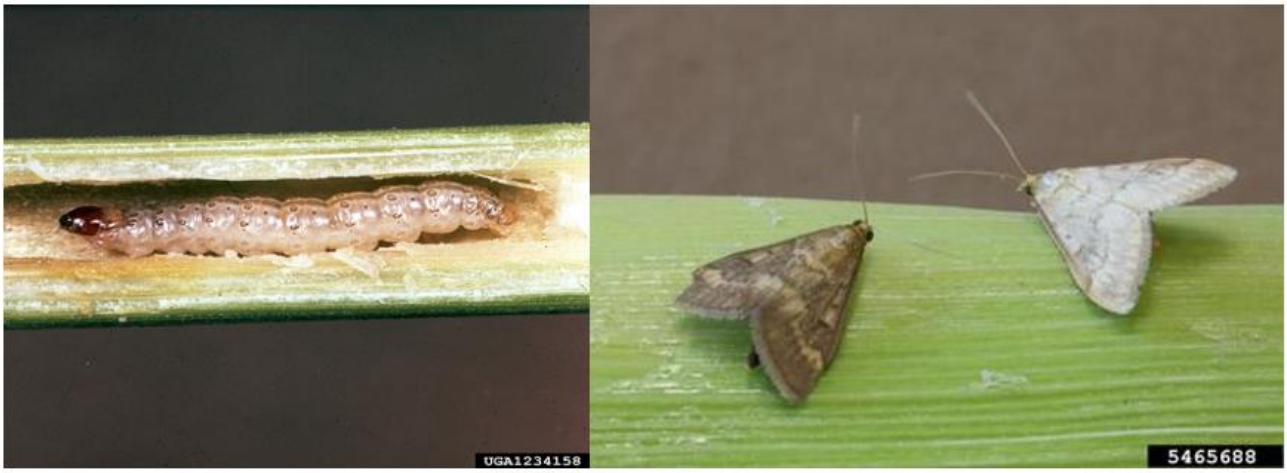

Figure 9. European corn borer (*Ostrinia nubilalis*). Larval tunnel (left) in a stem of maize © Clemson University – USDA Cooperative Extension Slide Series, Bugwood.org. Adult *O. nubilalis* M left F right © Adam Sisson, Iowa State University, Bugwood.org.

The larvae are highly damaging (Fig 9). The larvae damage plants when feeding within the stems. The major impact on the plant is nutrient loss and disruption of water transfer in the host, due to the internal damage of the stem. The tunnelling can also cause ear drop before harvest, preventing ears from being mechanically harvested. Stems are prone to

snap and break, which damages the crop and facilitates secondary infection by pathogens. Due to the feeding damage of the larvae, infested stands of maize are also more prone to being blown over in the wind.

Frass and bore holes are easily visible on stems, or on the apical part of maize ears. *Ostrinia nubilalis* is known to be established in England, with breeding colonies on waste ground in the south, and on the south coast of England around Portsmouth and Southampton. *Ostrinia nubilalis* is also a migrant to the UK from the continent, increasing local populations. There is no current information available on the distribution of the different races within the UK, but host preference suggests that previous records were of the “E” race, with the larvae predominantly feeding on *Artemisia* species. Any findings of this species on maize in the UK would be of significance, and any reports of this to the PHSI would help to map the distribution of the two races here in the UK.

Asian corn borer (*Ostrinia furnacalis*) is very closely related to the European corn borer. Its distribution is predominantly the Middle East, Asia and Oceania. Much like the European corn borer it is a pest, primarily of grasses, but it is also known to feed on other hosts, with its preferred host being maize. The larvae cause much the same damage as the European species with tunnelling of the stems and ear drop. Both these species are identical as larvae and can only be separated by dissection of the adults. Any *Ostrinia spp.* that are found in the UK in maize are generally assumed to be the European species. It is highly unlikely that growers will encounter the Asian species, but due to the high levels of similarity, any findings of *Ostrinia* spp. in maize in the UK should be reported to the PHSI and samples sent for species identification.

Advisory information

Suspected outbreaks of any notifiable pests should be reported to the relevant authority:

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, York.

Tel: 0300 1000 313 (please select option 3 when calling)

Email: planthealth.info@apha.gov.uk

For **Scotland**, contact the **Scottish Government's Horticulture and Marketing Unit:**

Agricultural crops contact the local RPID officer:
http://www.gov.scot/Topics/farmingrural/Agriculture/AOcontacts/contacts

For non-agricultural crops, email: hort.marketing@gov.scot

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch:**

Tel: 0300 200 7847 Email: planthealth@daera-ni.gov.uk

Web: https://www.daera-ni.gov.uk/topics/plant-and-tree-health

For additional information on UK Plant Health please see:

https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/

https://planthealthportal.defra.gov.uk/

https://www.gov.uk/plant-health-controls

http://www.gov.scot/Topics/farmingrural/Agriculture/plant/PlantHealth/PlantDiseases

https://www.daera-ni.gov.uk

Authors

Update Duncan Allen (Defra)
Date: March 2023