

## PLANT-PARASITIC NEMATODES ON MAIZE

### INTRODUCTION

Most producers are aware of the presence of plant-parasitic nematodes but symptoms resulting from nematode damage are not always specific and can easily be confused with symptoms typically associated with damage caused by pesticides, water logging and nutrient deficiencies. The impact of nematodes on maize yields is, therefore, often under estimated. From a survey conducted all over the maize production area during the 2008/2009 growing season, seventeen nematode groups have been identified to be as-

sociated with maize. However, for the purposes of this information guide only the two most important genera commonly present in maize fields will be discussed.

### IMPORTANT PLANT-PARASITIC GENERA ASSOCIATED WITH MAIZE

1. Root-knot nematodes (Meloidogyne spp.)

Root-knot nematodes are the most prominent genera throughout the maize



(Foto: Dr. Chris Schmidt: Sidi Parani)

Fig 1. Aboveground symptoms of maize in a nematode infested field.

production area. A typical root-knot nematode population in a maize field consists of mixed *M. incognita* and *M. javanica* populations. Both species have a wide host range, which means that they can parasitise and develop on crops other than maize. Under optimal conditions a root-knot nematode female can hatch from its egg and be ready to lay eggs in approximately 20 to 25 days. A single female can produce over 1 000 eggs during her lifetime. Damage that is already inflicted on the roots will, therefore, remain irreversible. The damage and reproduction potential of root-knot nematodes often increase during the rainy season, especially in seasons where an unnaturally high rainfall occurs.

Symptoms associated with root-knot nematode infestation

Aboveground parts of plants infested with root-knot nematodes are stunted, yellow and patchy in growth. These symptoms can typically be seen as yellow patches in the field that will never be evenly distributed (Fig. 1). In severely root-knot nematode infested fields plants may die before harvest.

Galls formed on the roots by feeding root-knot nematode females (Fig. 2) are not always visible and depends on the species as well as the number of nematodes feeding on the plant. Therefore, the absence of galls is not always indicative of the absence of root-knot nematode populations. If the galls are indeed



Fig 2. Root-knot nematode females (white) inside root tissue.



(Foto: Dr Chris Schmidt: Sidi Parani)

Fig 3. Galls formed by root-knot nematodes on maize roots.

visible (Fig. 3), it can be identified fairly easily on the roots and range in size and numbers. The galls are formed from giant cells induced from normal plant cells through feeding of the female.

#### Survival

In the absence of a suitable host crop root-knot nematodes are able to survive and reproduce on many weed species commonly found in maize fields. However, the main survival strategy of root-knot nematodes during the winter months is to survive in unhatched eggs present in the soil and in plant residue left behind in the field after harvesting. These eggs may stay in this resting phase for an unpredictable time and only hatch when conditions are favourable.

#### 2. Lesion nematodes (*Pratylenchus* spp.)

Lesion nematodes occur sporadic but when they do occur, it is usually in high numbers and can therefore not be underestimated. *P. zeae* and *P. brachyurus* are the most common lesion nematode species associated with maize and second only to root-knot nematodes. Of these two lesion nematode species, *P. brachyurus* is the most pathogenic and causes the most damage. However, when both species occur together in a field, the less pathogenic *P. zeae* will dominate *P. brachyurus* because of its shorter life cycle, faster reproductive

rate and higher tolerance to a wider range of temperatures. Both species thrive in a wide range of soil types. Moisture is an important factor affecting the reproduction and damage potential of these lesion nematodes, which can increase during the rainy season.

#### Symptoms associated with lesion nematode infestation

Plant height and chlorophyll content in the leaves are generally considerably reduced. Aboveground symptoms are, however, not highly specific because symptom expression is affected by the species present, the number of nematodes present at the time (population density) and environmental conditions. If aboveground symptoms do occur, it will be in patches like that of root-knot nematode symptoms.

Root damage by lesion nematodes can often be diagnosed by the presence of small lesions on the root surface. The feeding of the nematodes on the roots causes destruction of the epidermis, which is where the root hairs are formed. This may cause severe necrosis and damage to root hairs, which leads to a poor uptake of nutrients and water by the plant. Lesions caused by lesion nematodes can also be infected with fungi and bacteria (secondary infection). Symptoms caused by lesion nematodes on the roots are difficult to identify because it can be masked by and confused with symptoms other than that caused by nematodes.

Survival

When moist soil is allowed to dry out slowly, both lesion nematode species are able to enter anhydrobiosis. Anhydrobiosis is a resting phase in which the lesion nematodes are able to survive almost six months of drought. This survival strategy enables the nematode to effectively survive the period between two maize-growing seasons. Anhydrobiotics will return to full activity at the start of the rainy season when maize seeds start to germinate. Most of the population however, survives the dry seasons in unhatched eggs, which will only hatch when the seed starts to germinate and environmental conditions are favourable for the nematode to survive and develop.

DISTRIBUTION OF THE NEMATODES

Nematodes are microscopically small and cannot move long distances on their own. They must, therefore, rely on factors other than their own locomotion to move them from one field to another. Water is probably the most effective agent in distributing nematodes. Water from nematode infested fields and even that from irrigation channels or dams can re-infest fields serviced by those channels or dams. Nematodes can also rely on humans to carry them around. Soil and sometimes also plant rests on implements and on shoes of workers working in infested fields can contain eggs, which will then be transferred to the next field.

MANAGEMENT OF NEMATODES ON MAIZE

It is almost impossible to completely eradicate a nematode population in a field. A small number of eggs and/or nematodes will always survive, irrespective of the means by which a producer tries to control them. The main aim of nematode management is, therefore, to keep the numbers of the nematodes in the field low enough so that the damage they cause do not translate into economical losses for the producer (keeping the nematode populations below damage and economic threshold levels). The following management tools will help the producer to keep nematode populations below damage and economic threshold levels. Using two or more of these tools in combination with each other will provide even more advantages to the producer and will lessen the risk:

Chemical control

Most producers still rely heavily on chemical control to keep nematodes in check. Carbofuran, carbosulfan and terbufos are currently registered nematocides for nematode control on maize and can only be applied at planting. Care should be taken to follow the instructions on the label to the letter to ensure minimum impact on human and animal health as well as on the environment.

However, with unpredictable environmental conditions (eg an unnatural high

rainfall) the efficacy of nematicides for nematode control cannot always be guaranteed. Producers are therefore strongly urged to preferably combine the use of nematicides with another management tool.

#### Crop rotation

Crop rotation is one of the most important management tools available to the producer. Not only can crop rotation keep the nematode numbers under control, it can also increase the microbial diversity in the soil and increase the numbers of natural enemies that attack the nematodes. However, an effective crop rotation system depends on the nematode species present and to know the host preferences of the nematode specie. A successful rotation system will then include the susceptible crop (eg maize) followed up by poor or non-host crops.

#### Resistant cultivars

Resistant cultivars are a cost-effective, environmentally friendly management

tool that can easily be incorporated into existing pest management programmes. Once again it is essential to know the nematode species in the field since cultivars may only be resistant to one of the species. It will be a good choice to incorporate a resistant cultivar in the production system where possible and when available.

#### CONCLUSIONS

Even though a producer may follow every detail to the letter, factors such as a high rainfall or total lack thereof, unpredictable temperature ranges and soil texture may provide favourable conditions for nematodes to thrive. If a producer therefore suspects that nematodes might be a limiting factor in obtaining the maximum yield from his crop, it is recommended to send soil and root samples to ARC-Grain Crops Institute to be analysed for the presence of plant-parasitic nematodes.