Soil fertility and nematodes: is soil acidity a factor?

Prof Driekie Fourie and Dr Gerhard du Preez

The deterioration of soil fertility in agricultural production areas, especially with regard to soil acidity, raises concerns. Soil acidity costs the agricultural industry >R2 billion rand annually and this only for grain crops such as maize, sunflower, soybeans and sugar beans. The question therefore remains whether plant parasitic nematodes, the group that damage crops, and soil acidity have any "touch points".

Local grain farmers are largely aware of the destructive influence that plant parasitic nematodes (also called nematode species) have on their grain crops' growth and yield. Crop losses in maize are a given where bud root worms (*Meloidogyne*) dominate in Free State sandy soils, while soy and sugar bean harvests go through even more. Plant parasitic nematodes occur in the soil at some stage of their life cycle and since ground is also the medium in which crops are produced, it is therefore inevitable that what happens in the soil will have an impact on the host plant and present nematode populations.

Plant parasitic nematodes survive in soil with a wide range of pH values from 3 to 10. These unique organisms have highly specialised survival strategies that enable them to survive in extreme and/or adverse conditions. In acidic soils, it is b. However, metals are known to become more soluble and may lead to heavy metal toxicity. An example often seen in local production areas is the appearance of aluminium (Al) toxicity where grain crops' roots are usually blunt, thickened points tone (Fig. 1). The same symptoms are usually visible where high bud root worm populations occur. In many cases, bud root worm problems and Al toxicity were found to be associated when nematode analyses were done. If other pests and pests attack more such plants, with already lower resistance levels, even more yields will be fined.

But what about the nutrient status of plants? The three main nuances that are of interest to the effective cultivation of grain crops are N (nitrogen), P (phosphorus) and K (potassium). Of these three nutrients, K probably plays the most important role in protecting crops from plant parasitic nematodes. Besides the many functions K plays in plants, the most important thing about pests and pests is probably that it leads to thickened cell walls in e.g. plant roots. Increased stability in the cell wall tissue is promoted if K is optimally fertilized and the plant therefore has increased resistance to the attacks of pests and pests. When plant parasitic nematodes feed on plants, such plants are under stress and in times of drought or when other pests and pests also attack these plants, the plant experiences increased stress levels

In terms of bud root worms, a study in the U.S. showed that reduced population levels of these harmful nematode species were present in roots of host plants that K experienced deficiencies versus their counterparts who showed optimal K levels. In addition to cell wall thickening, K is also responsible for building turgor in plant roots and translocating water in the plant. Burdock root worms feed into the vascular tissue of e.g. grain crops (Fig. 2) where it changes the anatomy of the tissues, thus hindering the effective translocation of water and nutriënte. Bud root wormwood-infected host plants will subsequently wilt and not grow and develop optimally, thus also harming the nourishing bud root worms that will also not be able to optimally feed and reproduce. The application of optimal quantities K is therefore critically important for the optimal growth of the crop because it will make the plant "stronger". so that nematode can better withstand infestations. Reduced K levels lead e.g. to the fact that fewer carbohydrates are stored in plants and such plants are more susceptible to pests and pests.

However, the opposite was recorded for lesional worms (*Pratylenchus*) in soybean roots in another US study where the population levels of these nematodes were lowest where the highest K levels were present. However, it was at a pH of 4 where the acidity may have played a bigger role. . At this pH, the outer epidermal cells of the nematode-infected roots were also the thickest and made the plant more "resistant." From the western grain producing areas of Australie where barley, lupin and wheat are grown, it was again reported that significantly higher lesional worm numbers in low pH (5.1) soil numbers were present versus countries where lime was applied (soil pH of 6.7). The yield of the grain crops in countries with the low pH as well as the income of producers was therefore significantly reduced because the crops were more "susceptible" to the lesional worms.

Growers should take into account that several other factors, besides soil acidity, also play a role in the appearance and infection of crops by plant parasitic nematodes. Soil is dynamic and sustains life in the form of countless numbers of soil organisms, beneficial and detrimental, forming associations with each other and having an impact on the cultivation of crops. So there are a myriad of factors that need to be considered when producers search for the cause of poorly performing crops. Plant parasitic nematodes can e.g. survives in a variety of soil types, although these pests most often cause the most damage in cereal crops grown in sandy soils. Growers should be mindful of the appearance of plant parasitic nematodes in increased population numbers in sandy spots in lands. In sandy soils (98% sand) in the Free

State, bud root worms e.g. Over a four-year period in the 1990s, 50 grams of roots of monoculture maize increased from 4 individuals to 5 000 individuals – an increase of 1 250 times! The influence of such increased bud root worm numbers resulted in a 60% crop loss. This article highlights the maintenance of optimal fertilization levels to improve soil fertility and is aimed especially at soil acidity. The application of conventional fertiliser products, compost or animal manure-based products should always have the aim of keeping soil substrates as healthy as possible, thereby reducing the negative impact of pests and pests. In addition, producers should also follow an integrated nematode

feral strategy to keep the population levels of nematode species low so that crops can be produced sustainably.

Driekie and Gerhard are employed at the Unit for Environmental Sciences and Management, Integrated Pest Management, North-West University and can be contacted at:

018 285 3006 of driekie.fourie@nwu.ac.za

0741577407 of Gerhard. dupreez@nwu.ac.za

Fig. 1. Bud root wormwood-infected maize roots with thickened and swollen root tips visible which may also be representative of aluminium toxicity as well as dark coloured portions caused by other soil pathogens (Photo: Driekie Fourie, NWU).

Fig. 2. A bud root wormwood female (white arrow) that feeds into the vascular tissue of a soybean root and thus impairs the transport of water and nutrients in the root and to the aboveground parts as a result of the structural change of the tissue (blue arrow) (Photo: Driekie Fourie, NWU).