Little bugs, big problems

Tim Hart, Roberta Burgess and Hans Hugo

In 1999, small-scale farmers, organised in the Friemersheim Kleinboer Vereniging (FKV), purchased an under-utilised 100 hectare commercial farm near their village in the South-Western Cape (South Africa). This arrangement had been made possible through the South African Government's Land Reform Programme (see LEISA Magazine 19.3 pp 27-29). The newly acquired land had been left fallow for many years and in several places there were heavy concentrations of weeds such as Australian Black Wattle (*Acacia* sp.), Hakea trees (*Hakea* sp.) and Night Shade (S*olanum nigrum*).

Early harvests

After the purchase, the old farm was divided into two-hectare plots and distributed to the members of the FKV. Their first planting season was in 2000 when most of them cultivated a mixture of vegetables, maize and legumes. Deformities began to be noticed in some root vegetable crops by mid-2001. However, farmers observed that although crop growth was stunted in some parts of their smallholdings, the same crops did well in other areas. They immediately suspected that the condition of the soil was responsible for these irregularities. They knew they had cultivated all parts of their plot in the same way and had used the same inputs and practices. They did not know what the problem was and neither did local commercial farmers in the area.

Galls on the roots of a Honeybush plant. Photo: Tim Hart

Land with problems

During 2000, some of the farmers involved in the FKV began to work with researchers from the Agricultural Research Council Infruitec-Nietvoorbij (ARC) to establish a new economic crop, Honeybush (*Cyclopia* spp.), used as a herbal infusion and a potentially valuable export commodity.

During the sessions when researchers were training farmers and providing them with information on various aspects of Honeybush cultivation, the farmers began to talk about their crop problems especially the deformities and stunted crop growth in root and tuber vegetables. The researchers recognised that these signs suggested that there might be a high level of root-knot nematode infection in the soil of some of the smallholdings.

Soil problems explained

When the growth of some of the Honeybush plants at the trial site also appeared stunted, the researchers started to look more closely at the problem. An examination of the trial plantings revealed galls or knot-like growths on the plants' roots. Laboratory tests proved these galls were caused by root-knot nematodes. Root-knot nematodes are microscopic organisms that live parasitically in plant roots. They cause root knots or galls, which make it difficult for the plant roots to take up water and other nutrients. As a result plant growth is stunted and root vegetables such as carrots and beetroot become deformed. In this case the root-knot nematode involved was identified as *Meloidogyne javanica*. This organism can live in more than 700 species of plants, including most vegetables and a large number of weeds. The weeds that were present on the farmers' land – Australian Black Wattle, Hakea trees and Night Shade – and crops such as tomato and potato were known to be good hosts to the nematode. Many brassica species such as cabbage and cauliflower, however, are not and can be grown without problem. Working the plant material of these varieties into the soil after harvest bio-fumigates the soil and can help control the nematode population. In the absence of host plants, root-knot nematodes cannot survive for more than a year or two.

A meeting was held with interested farmers and the research team explained the effects of the root-knot nematode and suggested that crops should be planted that would not host these organisms. These crops could be planted and seasonally rotated with other crops to reduce the number of nematodes in the soil. Local commercial farmers used to rotate crops and this, together with other farming practices, may have been the reason why they had not experienced a problem with nematodes.

The farmers wanted to know how much of their land was infested with nematodes and asked the researchers to carry out a survey. Working together, farmers and researchers surveyed about 40 hectares of land over a two day period in September 2002 during which samples were taken from farmers smallholdings. Farmers were also asked about the history of their piece of land and to explain their crop planting and crop rotation practices.

When soil samples were analysed, researchers found there was a high level of infestation of root-knot nematodes on most of the smallholdings. Samples taken from land that had not yet been cultivated also showed a high presence of root-knot nematodes. Samples taken from plots where farmers had planted vegetable crops indicated even higher concentration of the pest. This suggested that their cropping practices might be making the problem worse.

This suspicion was confirmed when researchers analysed the survey data further and compared it to the data they had collected on the various cropping practices farmers had followed in the period 2000-2002. Most farmers had planted Irish potatoes – a favourite root-knot nematode host – season after season, without observing any resting period or crop rotation.

Mr Hans Hugo carrying out soil sampling. Photo: Tim Hart

Options

After the samples and the cropping practises had been analysed, three members of the research team met with each farmer on their smallholding and explained the extent of the nematode problem to them, advising them on possible strategies to reduce the numbers of root-knot nematodes in the soil. Researchers agreed that, once the farmers had selected the option that best suited their individual circumstances, they would help them draw up a proposal to obtain support and funds to tackle not only nematode infestation but also other soil health problems. In the FKV area these problems included poor soil fertility, soil borne diseases and inappropriate crop rotation systems.

Identifying locally appropriate solutions

The researchers suggested four options that could be used to restore soil health under present circumstances. Farmers could:

- Fumigate the soil with chemical soil fumigants;
- Plant marigolds and plough the plant matter into the soil before it began to form seeds;
- Plant oats on the affected soil for a few seasons to control and possibly arrest the root- knot nematode levels;
- Plant broccoli, cauliflower or cabbage and plough the plant material into the soil after harvest.

The options selected by individual farmers depended on their social and economic situation and the resources they had available. Some of farmers, for example, had access to alternative employment and income, which made them less reliant on agricultural production and better able to try out more costly and long-term measures than farmers who had no alternative source of income.

All the farmers immediately ruled out the fumigation option because of the cost and the long-term damage it could do to soil biology. They did not consider planting and ploughing in marigolds to be an appropriate strategy because whilst marigolds might control nematodes, they could not be eaten and they did not generate income. Farmers did not want options that involved spending money on external inputs or ones that would involve taking land out of production and a subsequent loss of income.

Some farmers decided to plant oats on their land because the crop could be used to feed livestock. Others were more interested in planting cabbages and other brassicas. All farmers wanted more information on the type of crop rotation systems that would reduce the nematode numbers.

While the researchers and farmers were developing a concept project proposal to address the soil health problem in an organic

Discussing cropping patterns with farmers. Photo: Tim Hart

and sustainable way, four farmers started using local resources to try and develop ways to control and reduce the presence of root-knot nematode. They did not use any external inputs but relied on low-external-input suited appropriate to their specific farming needs and providing immediate benefits.

Working together

Two farmers, for example, decided to combine their resources in order to tackle the root-knot nematode problem. In 2002, they agreed to plant oats on one of their smallholdings and food and cash crops on the other. In 2003, they intend to repeat this process. In 2004, they will plant oats where the food and cash crops had been and food and cash crops on the land where oats had been planted. These two farmers are considering the possibility of getting a third farmer involved in the process. Not only is this a good strategy as far as soil health is concerned, it also encourages the conservation of soil nutrients in general.

Honeybush field with low plant density probably due to root-knot nematodes. Photo: Tim Hart

Single plot rotation

In 2002, another farmer planted oats on three-quarters of his land and used the remainder of his plot for food and cash crops. In 2003, he ploughed in some of the oats and started planting cabbages at periodic intervals. He intends to rotate his vegetable crops each season. Like his colleagues who are also using the oats rotation, he intends to practise crop rotation on a regular basis and on a larger scale once the nematode population has been reduced on the land currently under oats.

A recent soil analysis showed that where oats had been planted for two consecutive years, root-knot nematode numbers remained low, while the number of free-living nematodes, which are non-parasitic and whose presence is desirable, had increased. This strengthened the theory that oats can have a role in reducing root-knot nematode population levels.

Increasing scale

In 2001, another FKV farmer who had a four hectares plot decided to plant cabbage and broccoli on one part of his smallholding. When the results of the nematode survey showed that he had the lowest number of root-knot nematodes he made plans to continue planting these crops. At the moment he is looking at ways of improving his crop rotation strategy because he wants to scale-up his crop rotational practices and completely rehabilitate his smallholding.

Future steps

Seeing the work being done by innovative farmers, two other smallholders made parts of their farm available for experimentation. At the moment this land is being planted with cabbages and these will later be rotated with other suitable vegetable crops.

Not all farmers are interested in taking part in experiments, however. Some have said they are going to wait to see whether the project proposal is successful in generating funds and further support, while others do not see the root-knot nematode problem as hindering their particular type of farming activity. There are also farmers who, for financial reasons, cannot change their cropping pattern even though they recognise that such a step might help them rehabilitate their land.

Conclusion

It is still too early to say whether the measures that farmers are trying to develop in Friemersheim will be effective in arresting or reducing the level of root-knot nematode infestation. At this stage we are unsure what other changes might have taken place. We also need to be able to account for the changes we have observed. Structured and regular soil monitoring is needed in all the areas where farmers are trying to develop new nematode management and soil health strategies in order to assess whether soil composition and nematode levels have changed as a result of their interventions.

Structured surveys of the soil where farmers have not introduced innovative practices are also necessary. The results from these surveys must be analysed and compared to those obtained in areas where measures are being undertaken to restore soil health. This type of data will give farmers the information they need on the effects their different interventions have had on soil content and nematode numbers over time and can be used as a basis for providing advice on soil management.

The experiences of those involved in experimenting with the options available to counter root-knot nematodes is also important given the proposals to introduce Honeybush into the area as a commercial crop. The recent soil survey showed, for example, that in areas planted with Honeybush there appeared to be a doubling of the root-knot nematode population, strengthening the suspicion that the pest was attracted to these plants.

Appropriate crop management systems, based on crop selection and rotation of locally important crops might be a viable low-input solution for containing or resolving the root-knot nematode problem. As the FKV experience shows the continuation of cooperation amongst farmers and between farmers and researchers is important to achieve this goal.

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- **Tim Hart**. Agricultural Sociologist, ARC Infruitec-Nietvoorbij, Private Bag X 5026, Stellenbosch, 7599. E-mail: tim@infruit.agric.za
- **Roberta Burgess**. Research Co-ordinator and entomologist, ARC Infruitec-Nietvoorbij, Private Bag X 5026, Stellenbosch, 7599. E-mail: roberta@infruit.agric.za
- **Hans Hugo**. Senior Nematologist, ARC Infruitec-Nietvoorbij, Private Bag X 5026, Stellenbosch, 7599. E-mail: hans@infruit.agric.za