# Nematodes as Bioindicators: Assessing the impact of sugar beet cultivations

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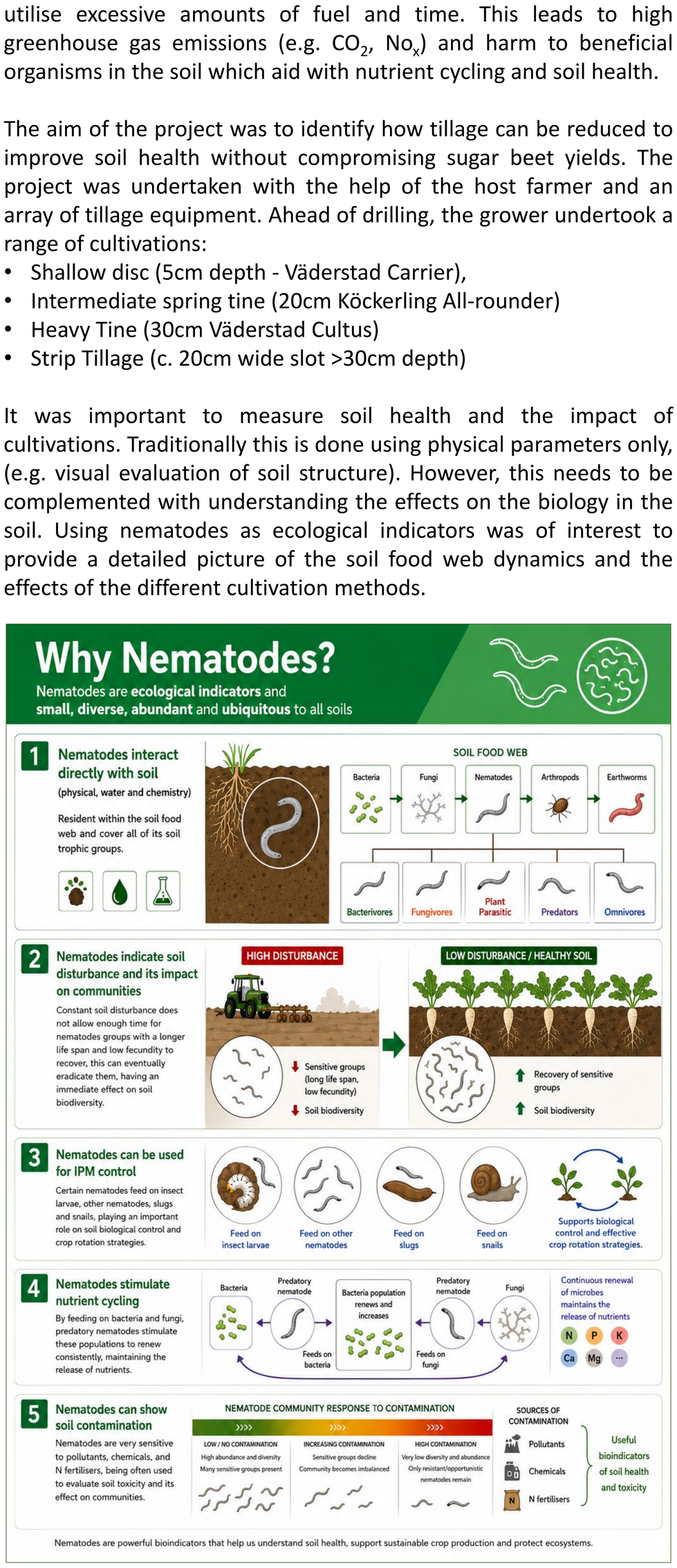
Establishment of an even plant stand of 100,000 sugar beet per hectare is essential to maximise yield. To ensure good establishment growers will often use multiple and deep tillage passes to create a friable seed-bed in which to sow their sugar beet. However, excessive cultivations can unnecessarily harm soil structure and utilise excessive amounts of fuel and time. This leads to high greenhouse gas emissions (e.g. $CO_2$, $No_x$) and harm to beneficial organisms in the soil which aid with nutrient cycling and soil health.

The aim of the project was to identify how tillage can be reduced to improve soil health without compromising sugar beet yields. The project was undertaken with the help of the host farmer and an array of tillage equipment. Ahead of drilling, the grower undertook a range of cultivations:

- Shallow disc (5cm depth - Väderstad Carrier),
- Intermediate spring tine (20cm Köckerling All-rounder)
- Heavy Tine (30cm Väderstad Cultus)
- Strip Tillage (c. 20cm wide slot >30cm depth)

It was important to measure soil health and the impact of cultivations. Traditionally this is done using physical parameters only, (e.g. visual evaluation of soil structure). However, this needs to be complemented with understanding the effects on the biology in the soil. Using nematodes as ecological indicators was of interest to provide a detailed picture of the soil food web dynamics and the effects of the different cultivation methods.




**Method:**

- Soil samples were collected 4 weeks after soil disturbance and sowing.
- Extraction of nematodes from soil using whitehead tray method.
- Taxonomic identification and counts of nematode genera / species, trophic groups assessment using dissection / compound image analysis microscopy.
- Assessment of nematode population dynamics using ecological indices.

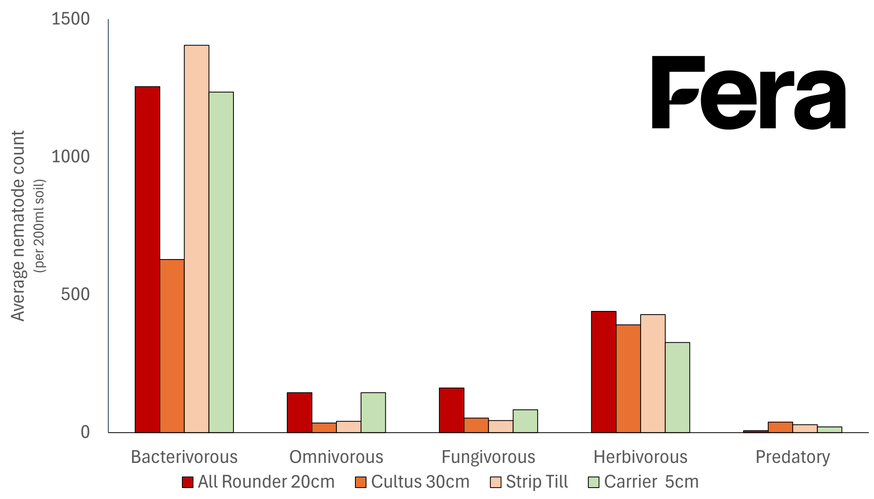
Fera conducted Nematode Bio-Indicator analysis, which identifies, and analyses shifts in the nematode community to determine whether the chosen cultivation is beneficial for good soil function

Strip-trial of various cultivation approaches which was used to investigate the influence of tillage intensity on the soil nematode communities

**Results:**

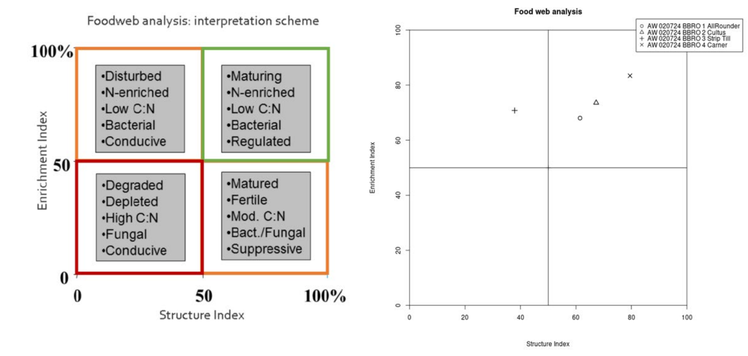
Counts of nematodes to determine the trophic diversity of the nematode community (Right)

Less disturbance protects higher-order nematodes from harm and encouraging their abundance and ability to provide ecosystem services such as nutrient cycling and predation of plant parasites




| Cultivation | Biodiversity Index | Maturity Index | Metabolic Footprint | Channel Index | Enrichment Index | Structure Index |
|---|---|---|---|---|---|---|
| All Rounder | | | | | | |
| Cultus | | | | | | |
| Strip Till | | | | | | |
| Carrier | | | | | | |

Summary of key soil health indices which are calculated using the soil nematode data: Soil health high/Soil health moderate/Soil health low




Interpretation diagram of the soil food web diagnosis (left) and representation of the analysed samples across the enrichment and structure trajectories (right)

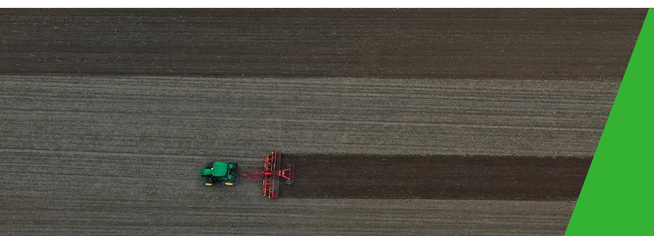
Nematode count and abundance data are then used to determine key indices (left) and can be combined to understand how the soil food web is functioning (right). Results show that the strip till treatment shows the greatest amount of disturbance. This is because the area sampled was the 20cm wide strips where the tillage occurred and tillage took place to a deep level (>30cm). Further investigations are required on more sites/seasons to see if this result is consistent, but this study has produced encouraging preliminary findings.

Analysis shows that the nematode communities responded differently and in a predictable way to the increasing levels of soil disturbance.

Nematode Bio-Indicator analysis provides a sound, evidence-based approach to aid informed decision-making for optimised sustainable land management whilst also maintaining productivity. Furthermore, identification and understanding of both beneficial and plant-parasitic nematode populations ensures IPM strategies can be tailored for best effect. Pest host preferences can be considered during crop planning to help reduce crop damage.

The findings highlight the power of ecological ecosystem assessments to enable growers to use ecosystem changes to monitor management decisions. This knowledge will help support growers in risk-based decision making to enable provision of more resilient soil management strategies and reduction of the use of chemicals.

While some may perceive beet industry practices as challenging to align with certain regenerative agriculture principles, BBRO is committed to leveraging ecological indices to assess soil disturbance and track ecosystem recovery in soils cultivated with beet.



This work was undertaken as part of BBRO's BetaSoils programme which is investigating the impact of tillage on sugar beet yield, productivity and greenhouse gas emissions.

BBRO would like to thank Holkham Farming Company for generously allowing us to undertake the tillage trials on their farm and providing the tractors and cultivators