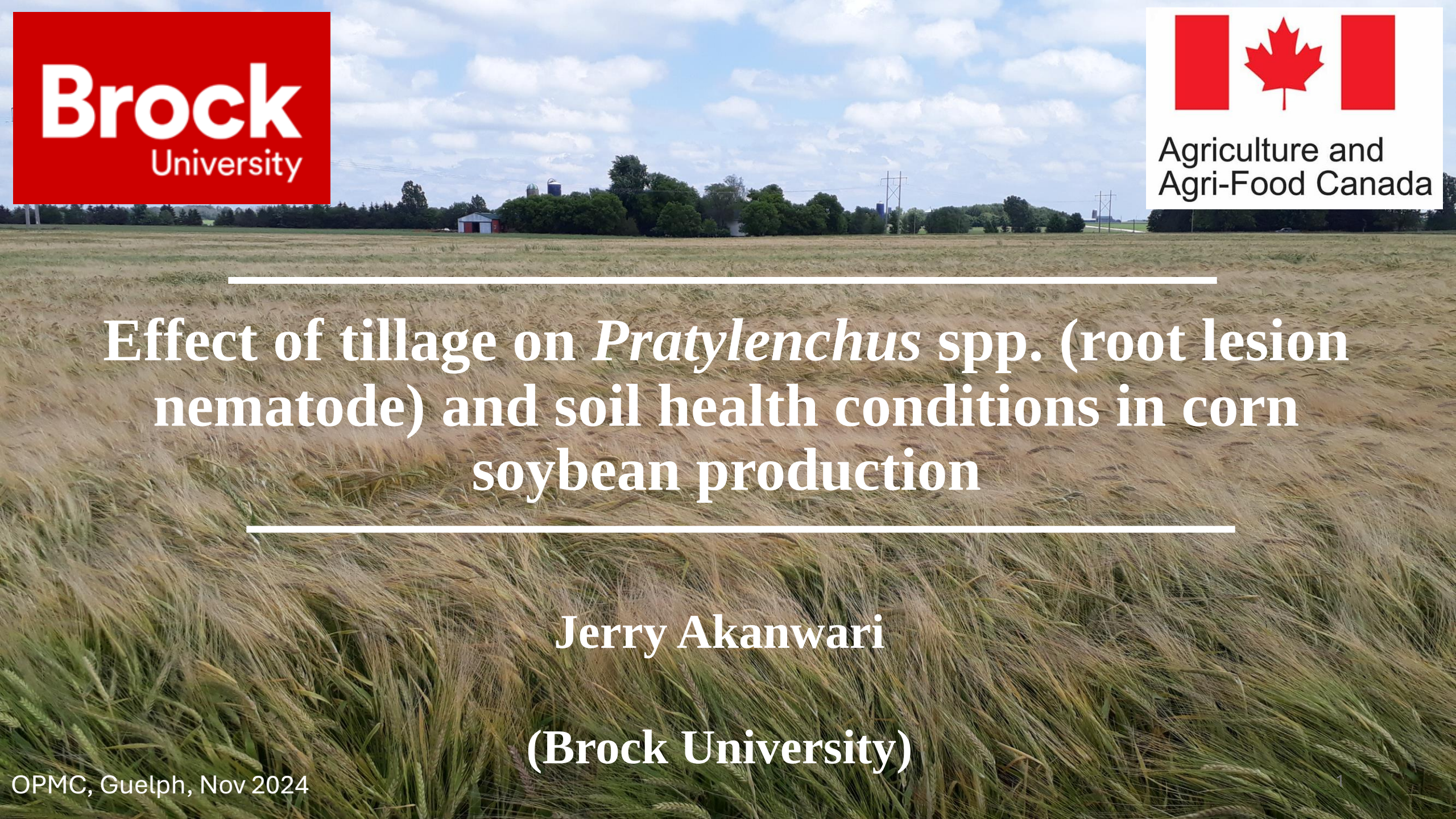


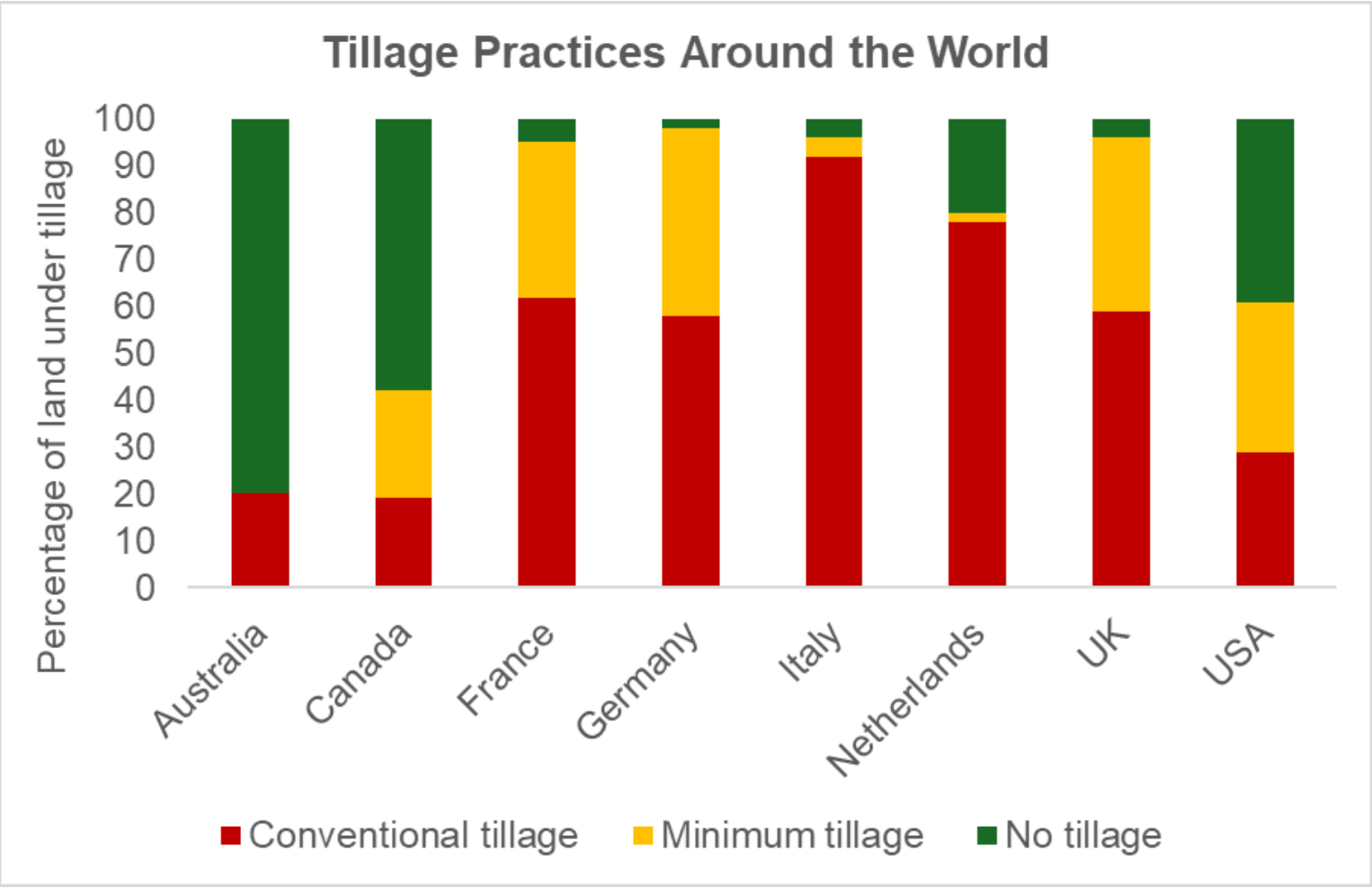
Effect of tillage on *Pratylenchus* spp. (root lesion nematode) and soil health conditions in corn soybean production

Jerry Akanwari

(Brock University)

OPMC, Guelph, Nov 2024

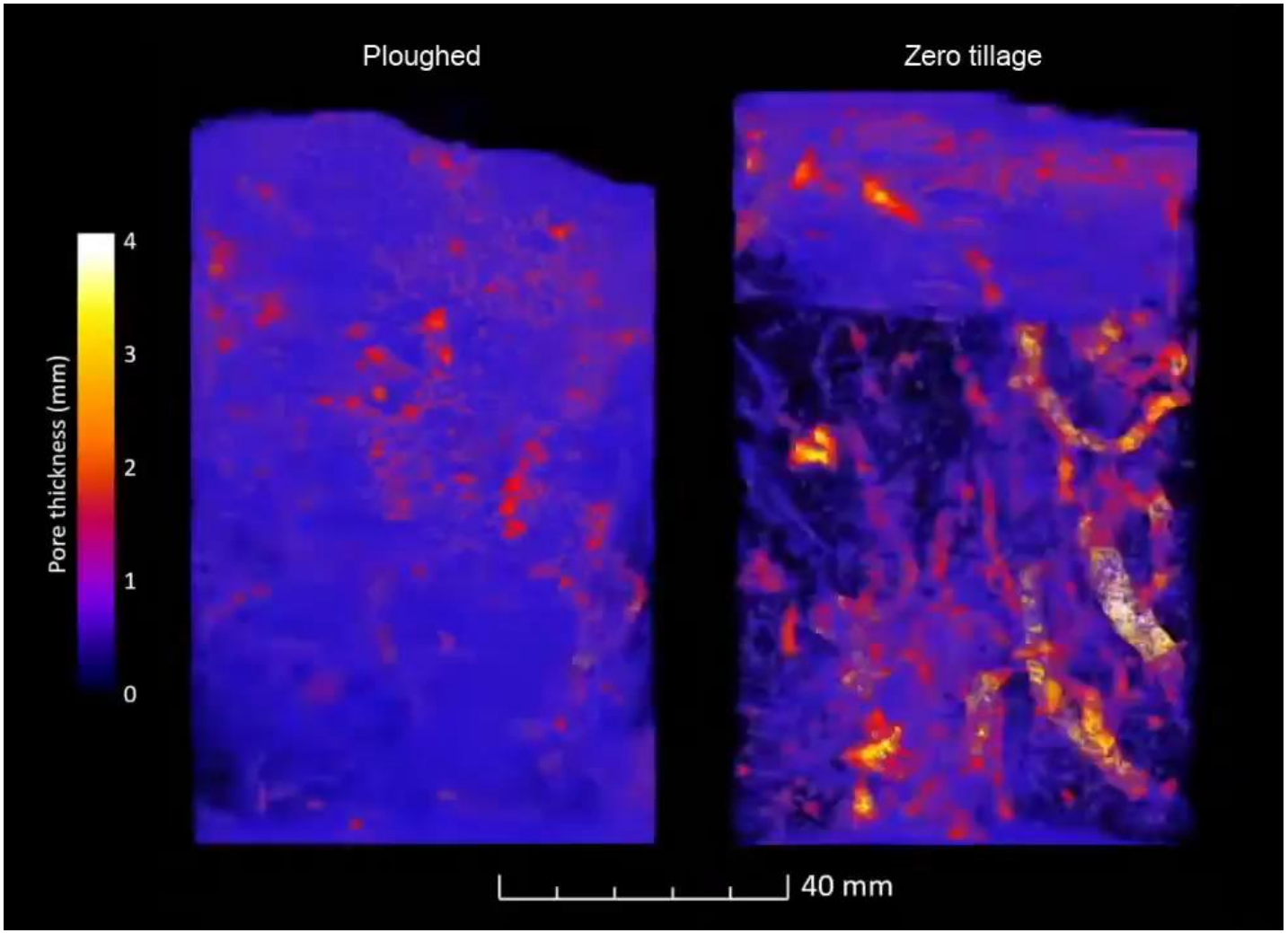
Global Comparison of Tillage Practice Adoption



Read et al., 2023

- Decreasing interest in conventional tillage worldwide
- Over 81% of Canadian land under conservation management (minimum and no tillage).
- 66% of Ontario's land managed under conservation tillage (Statistics Canada, 2022)

Benefits of conservation management



Video by Luke Wardak

💧 **Water Retention**: Helping soil hold moisture, making crops more resilient to drought.

🌍 **Carbon Storage**: Capturing and storing carbon in the soil, supporting climate stability.

🌱 **Nutrient Cycling**: Transforming raw materials into plant-ready nutrients for healthier growth.

🚜 **Low production cost**

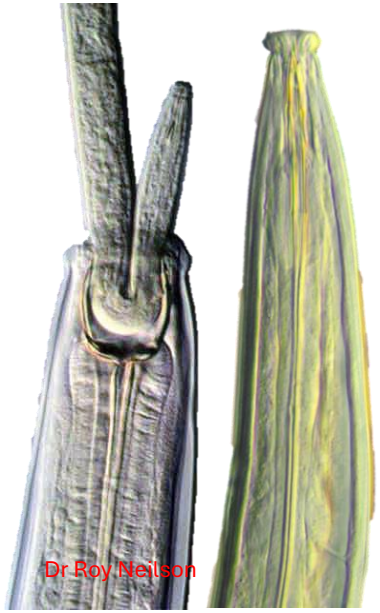
Tillage impact soil biological activity (Nematode community)

Bacterivores

Fungivores

- Soil mineralization (30% of N)
- High disturbances

Predators



- Soil is resilient
- Stable environment

Plant-parasitic nematode (PPN)

Nematodes cause $157 billion in global losses, 5-15% in Canada

Beneficial free-living nematodes **(**bacterivores, fungivores and predators) can be used as bioindicators to **measure soil quality**

Pratylenchus

Effect of tillage on root-lesion nematode *Pratylenchus* spp.

- Third most important PPN in Nematology
- Most serious and common pest in Canada (12 described species)
- Several crops are good hosts e.g. corn, soybean, potato, vegetables, fruits, etc.
- Limited management options.
- Impact of tillage on *Pratylenchus* spp.: Inconclusive Findings;

Bélair et al., 2018; Jones et al., 2023

Hypothesis

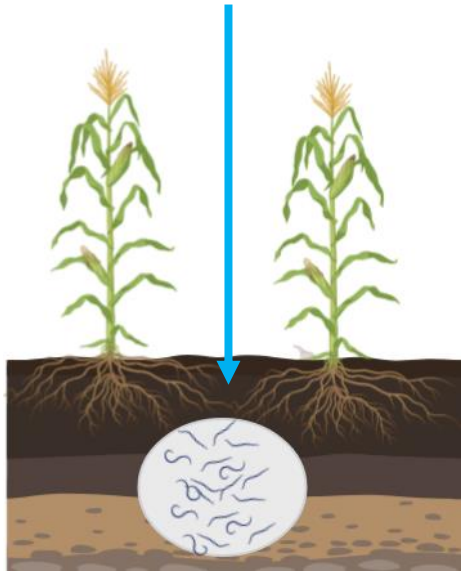
No tillage

Pratylenchus

Free-living nematodes

No tillage system will promote high abundance of *Pratylenchus* spp.

The NT system would promote a more stable system due to decreased soil disturbance



Main crop stage

Objectives

- ❑ The impact of tillage on *Pratylenchus* spp.
- ❑ Effect of tillage on soil health conditions

Materials and Methods

Conventional tillage (CT)

Minimum tillage (MT)

No tillage (NT)

- Study location: Wallenstein, Ontario
- Year of study: 2021 and 2022
- Design: Randomized complete block design
- Replication: 4
- Sampling: Soil samples collected twice a year
- Depth of soil sampling: 0-5 and 5-20cm

Experimental setup and time of soil sampling



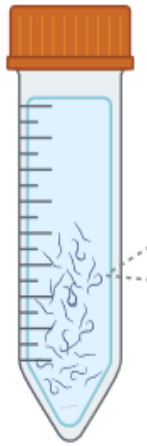

October - 2020	April - 2021	September - 2021	October - 2021	April - 2022	September - 2022
Experimental setup and rye seeded	Rye harvest, followed by tillage and corn Seeding	Corn harvested	Tillage applied and barley planted	Tillage and soybean planted	Soybean harvested





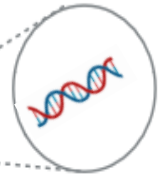

Analysis workflow

1



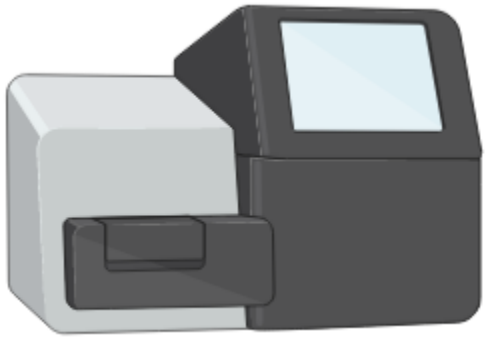
Nematodes isolation

2



DNA extraction

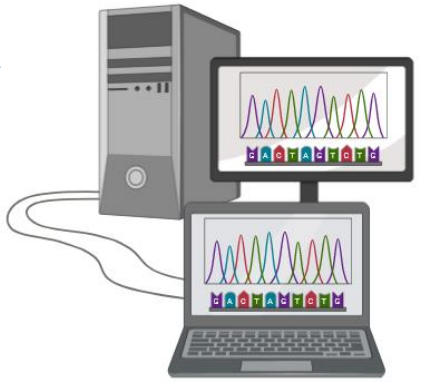
3



DNA sequencing

- 18S NF1 primers
- Illumina Miseq
- Pair-end sequencing = 2 x 250 bp

4



Bioinformatic analysis
(Nextflow / Liang's pipeline)

- Pre-processing.
- Alignment to nematode reference sequences.
- Taxonomic assignments (NemaTaxa database)

5

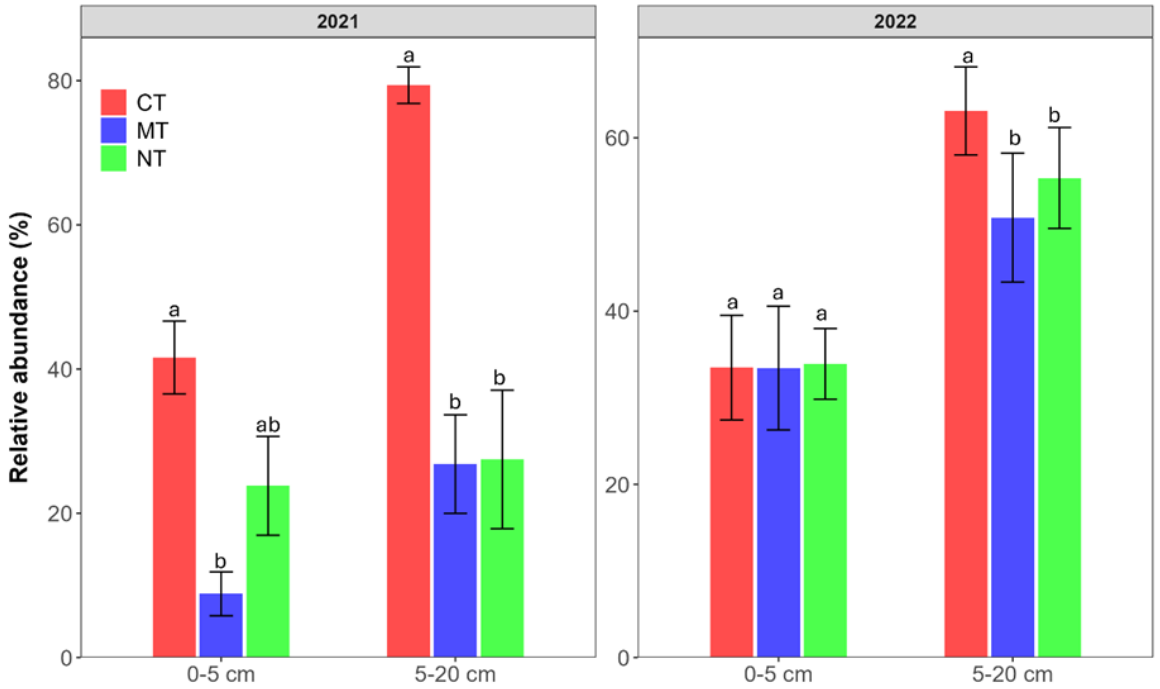
Ecological assessments

- R studio

RESULTS AND DISCUSSION

Effect of tillage on Plant parasitic nematodes (PPNs)

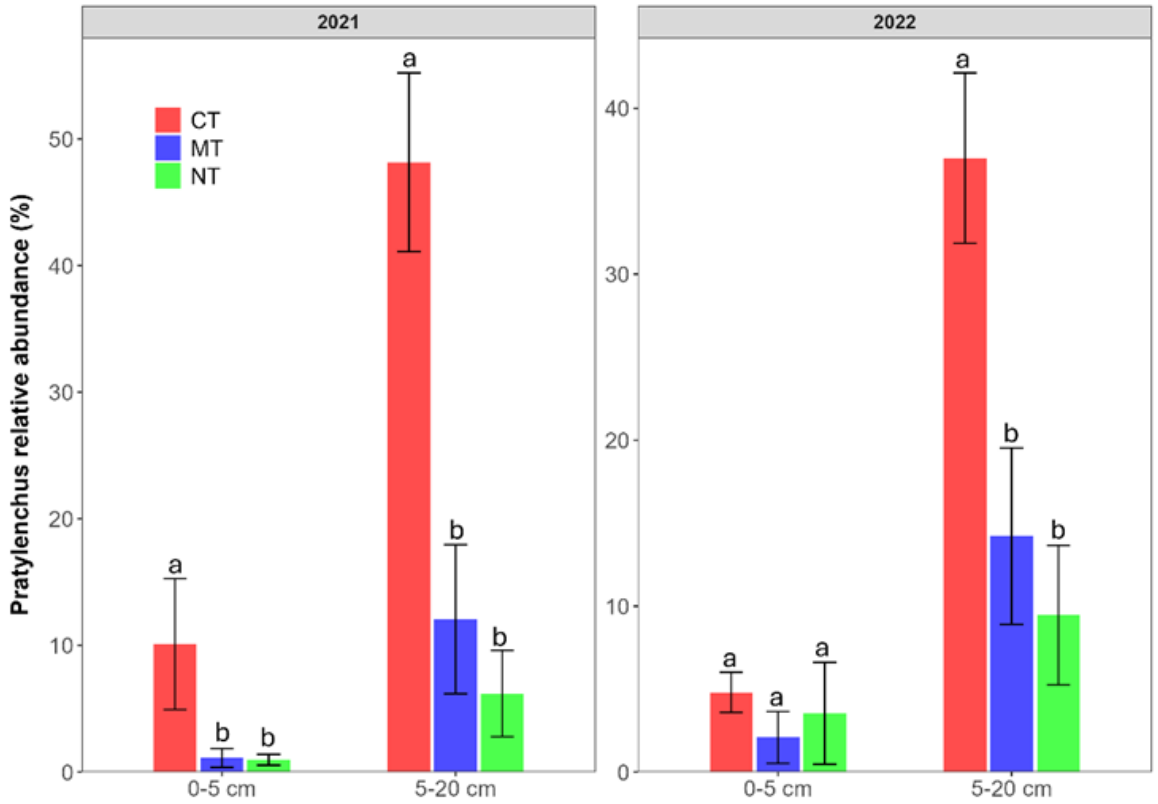
- 2021: PPNs were significantly higher at both depths under conventional tillage (CT).
- 2022: No significant difference at 0-5cm but CT had higher abundance of PPNs at 5-20cm.
- PPN populations were steadily increasing over time at minimum tillage (MT) and no tillage (NT) systems.



Effect of tillage on the relative abundance of PPNs. CT = Conventional tillage, MT = Minimum tillage, NT = No tillage

Effect of tillage on *Pratylenchus* spp.

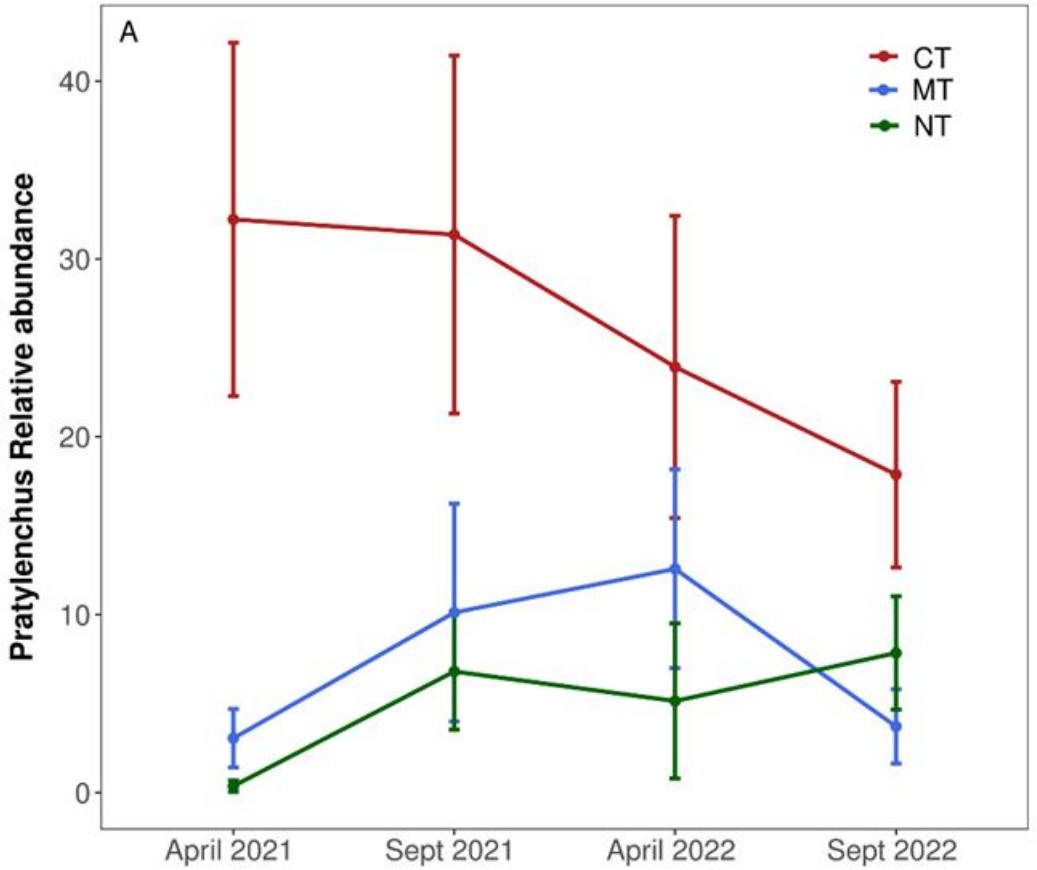
- 2021: CT had significantly higher abundance of *Pratylenchus* at all depths.
- 2022: No significant difference of *Pratylenchus* at 0-5cm but CT had higher abundance at 5-20cm.
- In 2021 and 2022, *Pratylenchus* abundance was similar between NT and MT at both depths.



Effect of tillage on the relative abundance of *Pratylenchus*. CT = Conventional tillage, MT = Minimum tillage, NT = No tillage

Effect of tillage on *Pratylenchus* spp.

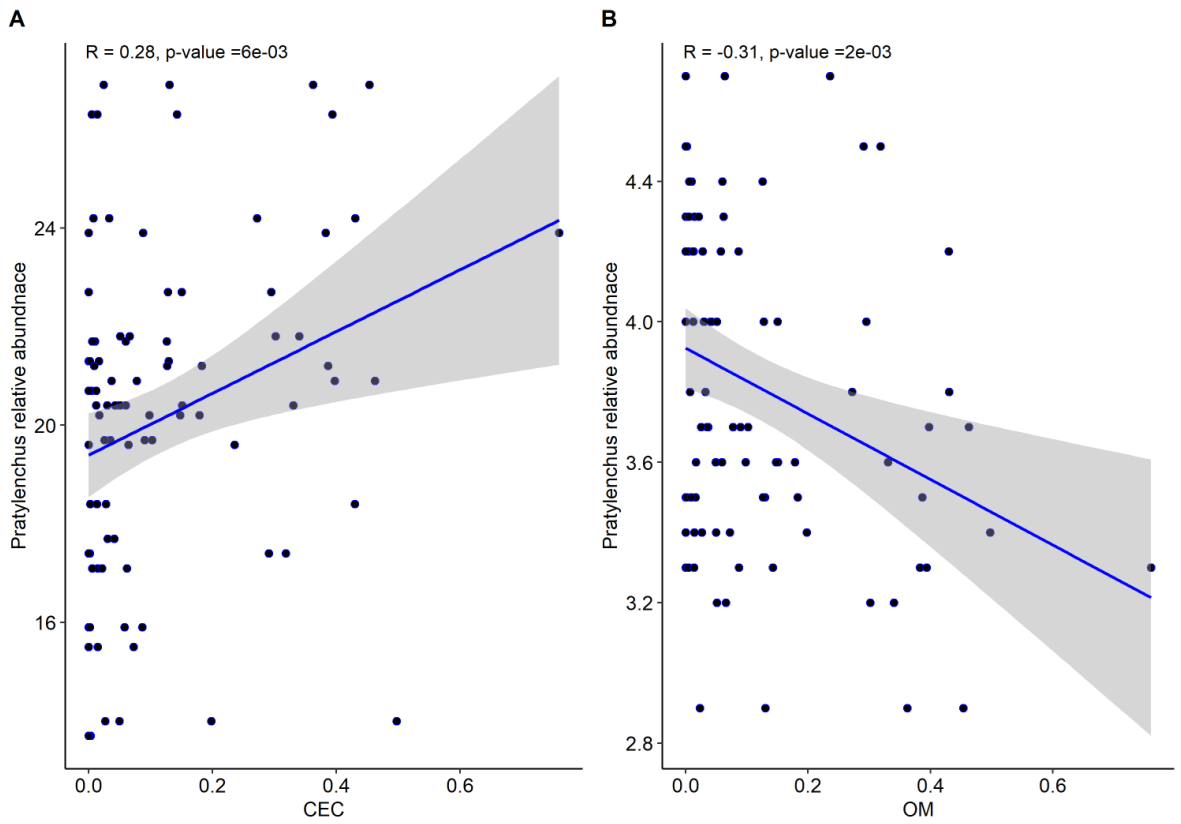
- Although *Pratylenchus* abundance was higher under CT, it showed a decreasing trend over time
- *Pratylenchus* populations showed an increasing trend in the MT and NT systems over time.



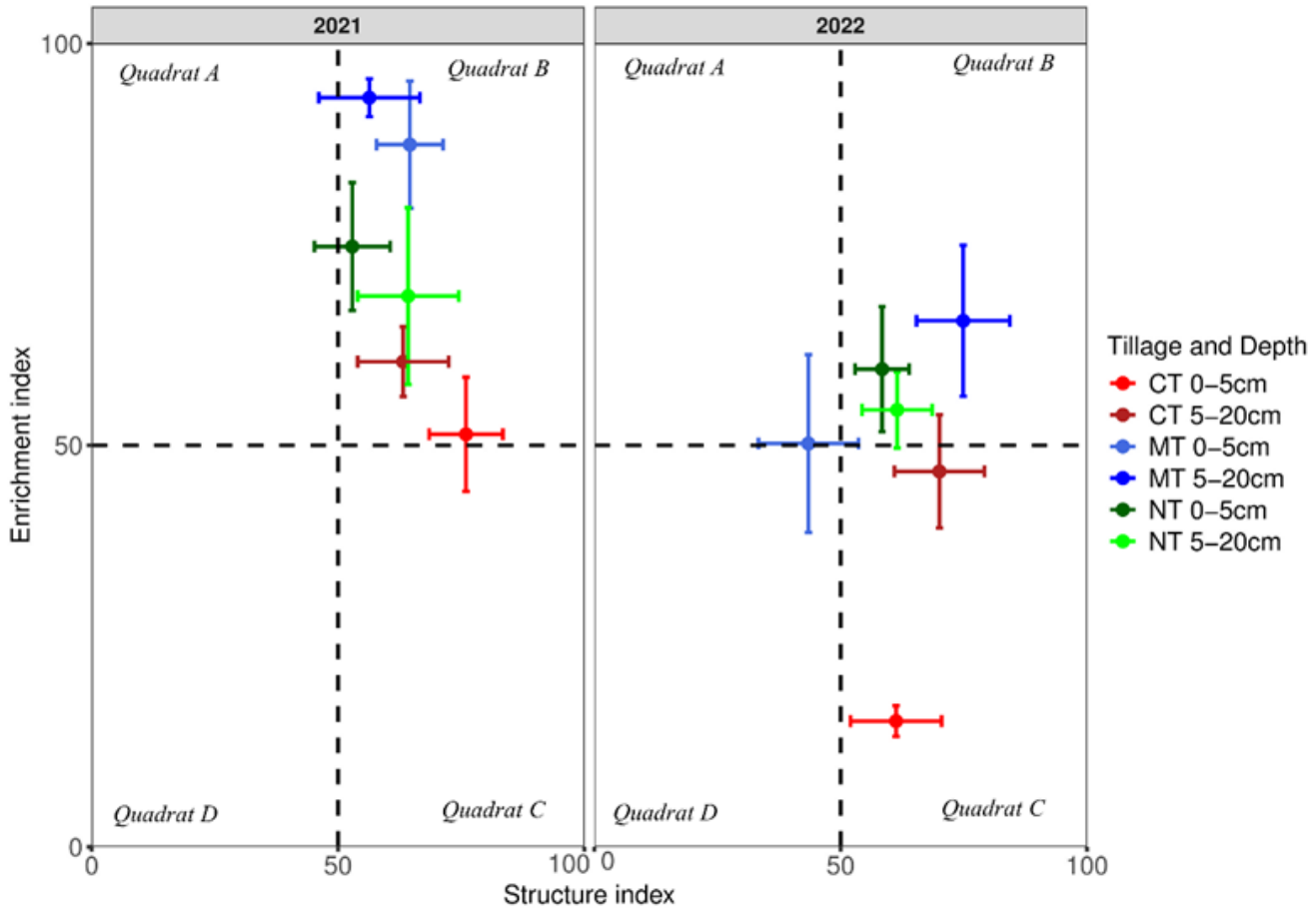
Variation in the relative abundance of *Pratylenchus* across the different sampling time. CT = Conventional tillage, MT = Minimum tillage, NT = No tillage

Effect of tillage on Pratylenchus

- CEC was significantly positively correlated with the relative *Pratylenchus* abundance.
- Organic matter was negatively correlated with the relative abundance of *Pratylenchus.*



Effect of tillage on soil health conditions



Food web analysis of nematode communities and their positions as soil health indicators

- Enrichment index: Measures the activity and nutrient cycling potential of the soil food web.
- Structure index: Assesses soil stability and its potential to other nematodes such as PPNs.
- Quadrat B: Ideal soil condition. Maturing, nitrogen enriched, low C:N, Bacterial regulated
- Quadrat C: Matured, Moderate C:N, Fungal / bacterial regulated

CONCLUSION

- Contrary to our hypothesis, CT increased the population of plant-parasitic nematodes especially *Pratylenchus* spp.
- MT and NT system was associated with ideal soil health conditions.
- MT and NT are expected to enhance soil health and biological activity, making the soil more resistant to plant-parasitic nematodes over the long term.

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Thank you

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