Feeding pests as an IPM strategy: wireworms in conservation agriculture as a case study

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FEEDING PESTS AS AN IPM STRATEGY

Wireworms in conservation agriculture as a case study

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Context

• Wireworms (WW) (Fig.1), the larvae of click beetles (Coleoptera: Elateridae), have been damaging a wide range of crops worldwide since long [1-3].

Fig. 1. Wireworms

• Conservation Agriculture (CA) combine three principles [4] :

Minimal tillage and soil disturbance

Permanent soil cover with crop residues and live mulches

Crop diversification and intercropping

• This system is increasing worldwide as a low-input system.

• By not disturbing the ground, CA increases soil-dwelling populations including insect pests.

* * *

We have investigated the influence of CA principles on wireworm populations and their harmfulness by addressing the 3 following questions:

1. Does reduced tillage increase WW populations ?
2. Does permanent organic soil cover limit crop damages?
3. How crop diversification and intercropping limit crop damages?

Results (1)

Does RT increase WW populations ?

• Long-term experiments :

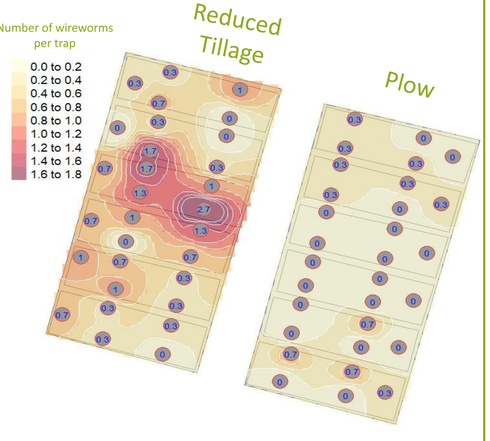

Fig. 2. Wireworm infestations after 6 years of reduced tillage compared to plowing (bait traps)

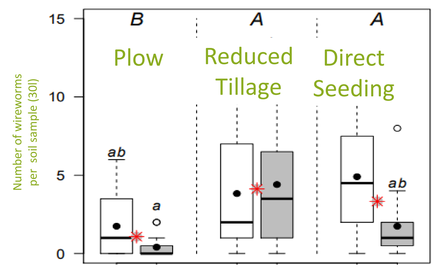

Fig. 3. Wireworm infestations after 19 years of reduced tillage and direct seeding compared to plowing (soil samplings)

• *Our results in experimental platform (Figures 2 & 3) demonstrate that reducing tillage increases wireworm populations.*

Results (2)

Does soil cover limit damages on maize?

• Glasshouse experiment :

• *The influence on maize damage of two types of soil cover (1) wheat seeding and (2) bark mulch was compared to the control (bare soil).*

• *2 Agriotes lineatus wireworms aged under 1 year and previously unfed during 4 weeks were placed in 0.25ml pot of a mix of sand and potting soil.*

• *In treatment 1 (T1) soil was left bare, in T2 9 seeds of wheat were sown and grown, and in T3 soil was covered with bark wood.*

• *After 14 days, wheat seedlings were cut and maize sown (1 seed per pot)*

• *21 days after sowing, seedlings were removed and the presence of symptoms monitored.*

Fig. 4. Percentage of maize seedlings damaged by wireworms according to the type of soil cover

• *Our results (Figure 4) show that the soil organic cover protects maize seedlings only when organic matter is fresh.*

Results (3)

Does intercropping limit damages on maize?

• Field experiment :

• *The influence on maize damage of wheat intercropping as companion plant was compared to the control (bare soil) and to a chemical treatment (Belem, 13kg/ha).*

• *The sowing date was May 10th, 2019*

• *Crop damage was assessed on June 11th, 2019*

Fig. 5. Percentage of damaged maize seedlings

Fig. 6. Maize seedlings damaged (on the right) and protected with wheat companion plant (on the left)

• *Our results (Figures 5 and 6) show that intercropping protects maize seedlings from wireworms damages.*

Discussion

• *In this study we explored how the 3 principles of conservation agriculture influence wireworm populations and their harmfulness*

• *Our results on long-term experiment evidenced that reducing tillage entails a marked increase in wireworm populations.*

• *Once this is acknowledged, the interesting point is to understand how CA systems can deal with the presence of crop pests. Our results in glasshouse experiment show that soil organic cover protects seedlings only when organic matter is fresh and results in field experiment show that intercropping protects seedlings from wireworms damages [4-5].*

• *Considering that Elateridae feeding phases could represent only about 20% of their lifespan [6], we assume that the input of fresh organic matter deflects wireworms from maize seedlings long enough to allow them to reach tolerance to soil dwelling pest attack (i.e.8-leaf stage).*

• *The manipulation of pest feeding behavior using companion plants and their spatialization opens promising perspective for Integrated Pest Management [7].*

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