

A close-up photograph of a wireworm, a yellowish-orange, segmented insect, crawling in dark, crumbly soil. Several yellowish, speckled potatoes are visible in the foreground and background, some partially buried in the soil. The wireworm is positioned near the top center of the frame.

Wireworm

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Wireworm

Problems increasing in UK and Europe

- Growers, packers, advisors, all agree
- Less of a problem in Northern England/ Scotland?
- Problems also being seen in veg crops
- Cereals after long term stewardship

Also have caused major problems recently in

- Canada / USA

Wireworm

Situation we faced in UK

- Problems increasingly hard to predict, no longer simply old grassland
- Bait trapping was inconsistent at best
- No real protection available for crops (final straw)
- No real improvement on the horizon
- **Somebody needed to do something quick**

Wireworm

Work carried out 2020-2022

- Research review for CUPGRA (NIAB) with Dr Marc Allison
- This resulted in
 - Improvements for: Risk assessments, trapping & monitoring.
 - Identified critical points in a rotation
 - Potential for some plant species to resist wireworm feeding?
 - Potato variety differences identified, factors involved need work.

Wireworm

Projects in UK 2022

- More work with NIAB, looking at rotation effects
- 2 trials to look at variety differences
- Branston / Beehive: Detection on cultivation equipment
- Fera: Enigma 1 (DNA identification of species + more)
- IF/ Soil Association: Identify management factors in autumn.
- PP EAST: Looking at chemical control
- Also sharing ideas/ results with researchers in France.


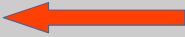
Species

Species

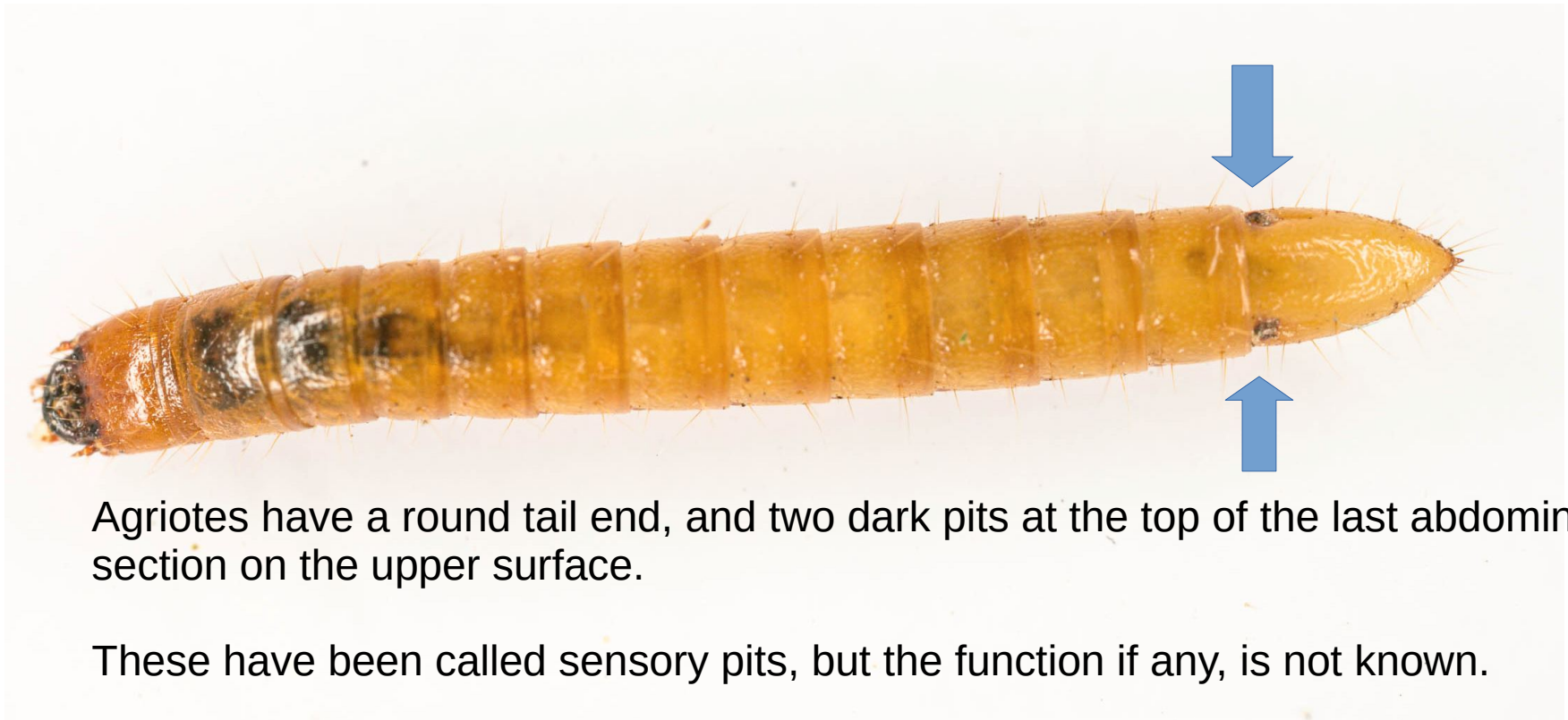
- ♦ Wireworm are click beetle larvae
- ♦ Uk > 70 species exist, we hope to learn more (Enigma1).
- ♦ **Agriotes** *lineatus*, *obscurus*, *sputator* our main pest species.
- ♦ Most species are not crop pests.
- ♦ No evidence of important species change (but no surveys).

Species

DNA identification by Sinsoma 2022

Cambs	<i>Adrastus pallens</i>	2
Norfolk	<i>Adrastus pallens</i> 	2
Somerset	<i>Agriotes lineatus</i>	1
Suffolk	<i>Agriotes lineatus</i>	2
Bucks	<i>Agriotes obscurus</i>	1
Norfolk	<i>Agriotes obscurus</i>	1
Cambs	<i>Agriotes obscurus</i>	2
Suffolk	<i>Agriotes sputator</i>	5
Cambs	<i>Hemicrepidius niger</i>	1
Norfolk	<i>Hemicrepidius niger</i> 	1

Species



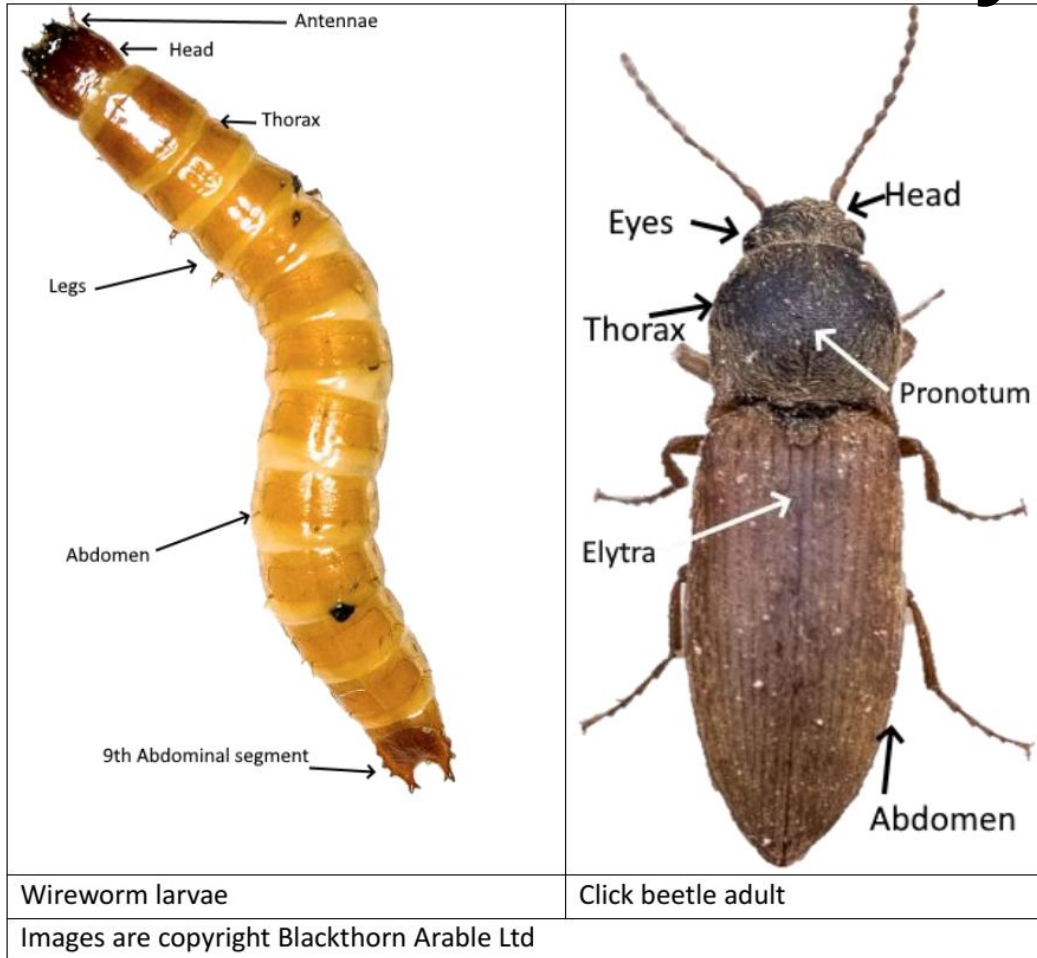
Agriotes have a round tail end, and two dark pits at the top of the last abdominal section on the upper surface.

These have been called sensory pits, but the function if any, is not known.

Understanding the life Cycle

(This is *critical*: What, when, where.)

Life Cycle



4 years

12 months-max



2-3 weeks

Life Cycle

- ♦ Larvae: Typically in soil 4 years, pupate (Aug-Sept)
- ♦ Adult beetles live < 1 year, emerge in spring.
- ♦ Egg laying occurs, May-June typically
- ♦ Young larvae hatch in summer and MUST FEED until winter.
- ♦ **It is easier to control the early stage (neonates).**

Increase?

- ♦ Why is it getting worse?
- ♦ Fewer insecticides in soil, OCs, OPs, Carbamates.
 - ♦ Cereal seed treatments, in furrow in beet, veg etc
- ♦ Little tillage after cereal crops + more green cover in autumn.
- ♦ **More greening & biodiversity ⇒ more species, inc pests.**

Risk

High risk rotations

- ♦ Just 2 years of grass leys, stewardship, lots of cereals.
- ♦ **Autumn:** green cover/ weedy stubbles, no cultivation.
- ♦ Cereals + autumn cover is similar to grass.
- ♦ Areas of grass of any kind around fields.
- ♦ The effect of old grass or set-aside persists with min till.

High risk rotations

- ♦ It is not what happens
- ♦ But WHEN!
- ♦ So ploughing mid winter, much less effect on populations.

Identifying populations

Working out how to make bait traps work!

Detecting larvae

- ♦ Bait traps or direct core sampling?
- ♦ **Bait traps detect low populations better than core samples**

BUT

- ♦ Must be used in the right conditions!
 - ♦ Autumn or in spring when soil **>8C**
 - ♦ Avoid extremes of wet or dry soil.

Bait trapping

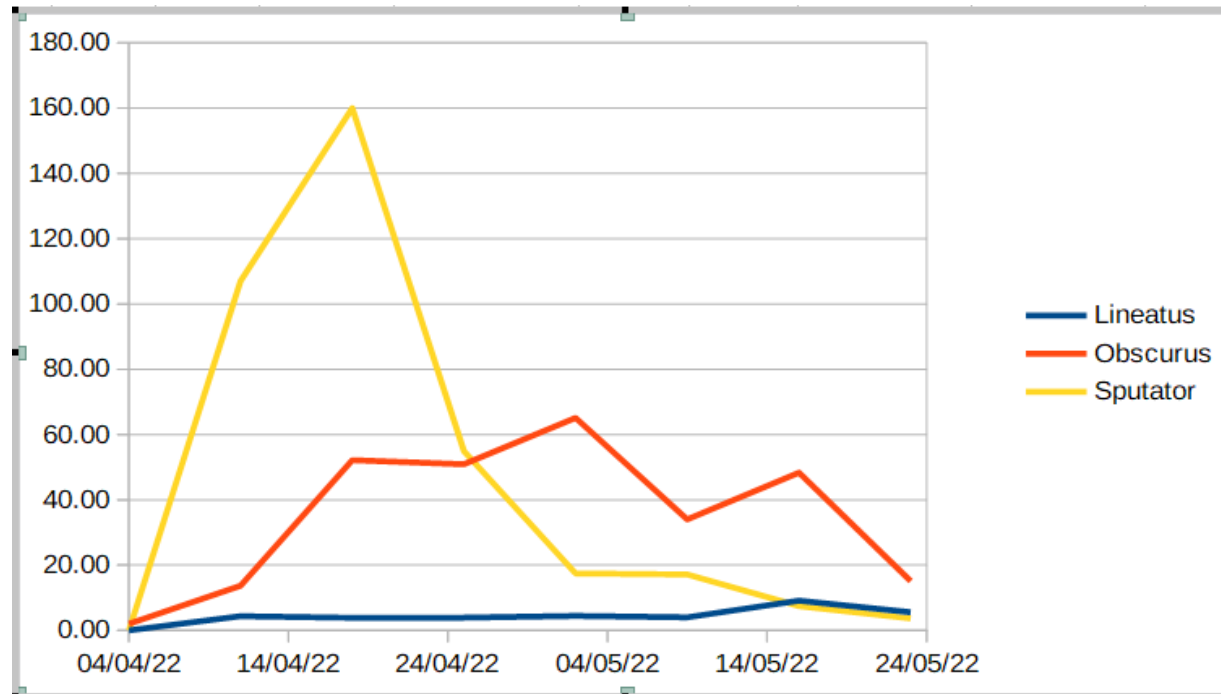
- ♦ Needs a Co₂ source
 - ♦ Germinating maize / wheat
- OR
- ♦ Based on rolled oats+water
- ♦ Protocol available for bait trapping.



Blackthorn Arable Ltd 2021

Detecting adults

- ♦ Pheromone traps for adults, useful indicator of activity
- ♦ **No direct correlation with larvae**



Control

What can we do?

Control



- ♦ Nothing will stop a high population damaging a crop
- ♦ Try to break the life cycle earlier in the rotation
- ♦ Control the young larvae while they are vulnerable.
- ♦ This is not going to be easy.

Control

- ♦ Ideally we would control young larvae after a cereal crop
- ♦ **Possibly** alternative cover crop species, eg mustard, buckwheat, trefoil, beans?. As yet unproven in UK.
- ♦ Or with biofumigation
- ♦ Potential control using EPF
 - ♦ In rotation crops, or against adults (needs work)

Effect of crops

Not all crops are favoured (000s per acre)

Crop grown in 1941	Population May 1941	Population June 1942	% of starting population
Grass	550	650	118
Wheat	725	725	100
Barley	750	900	 120
Oats	525	550	105
Sugar beet	875	625	71
Potatoes	775	650	84
Flax	800	725	91
Beans	950	225	 24

Evans 1944

Cultivations

Cultivations

- ♦ Multiple effects: **Removal of food**, direct kill, exposure.
- ♦ All three sensitive stages are present in late summer. Neonates, pupae and new adults.
- ♦ Effect of cultivation on larger larvae possibly overestimated (speed vs predation)
- ♦ Non inversion methods were shown to be ineffective (Lole 2010)

Effect of variety

Effect of variety

- ♦ Most varieties still suffer damage to some extent
- ♦ Differing opinions on the exact reason
 - ♦ Periderm TGA & reducing sugars (*Olsson & Jonasson 1994*)
 - ♦ Glucose & fructose (*Bagheri, & Nematollahi 2007*)

Effect of variety

Difference in varietal susceptibility to damage
in no-choice feeding test

< 20 % feeding damage	20-50 % feeding damage	> 50 % feeding damage
Maris Piper (10 %)	Harmony (20 %)	Mayan Gold (50 %)
King Edward (15 %)	Nadine (25 %)	Rooster (60 %)
	Estima (30 %)	Marfona (65 %)
	Cabaret (35 %)	Maris Peer (65 %)
	Saxon (35 %)	
	Orla (45 %)	

Actual amount of damage (percent of tuber) in brackets.

Summing up

Action Plan

- ♦ Improve the overall risk assessment
- ♦ Identify the population level (bait-trap, observe)
- ♦ Learn about the adult activity (pheromones).
- ♦ **Identify damage earlier in your crops, wash tubers.**
- ♦ Consider a more tolerant market for high risk crops.

Action Plan

Target juveniles

- ♦ Create a plant free situation after a cereal crop +/- cultivate?
- ♦ Consider biofumigant for neonates + wilts + PCN etc.
- ♦ Consider the rotation & cover crops carefully
- ♦ Count down the years to the next crop

What next?

- ♦ Various projects now underway or proposed
- ♦ Better understanding of the biology and species
- ♦ Identify plant species they cannot survive on

Thank you