RISK ASSESSMENT IN AN AGRONOMIC CONTEXT – DIRECT AND INDIRECT IMPACTS OF NON-CHEMICAL MANAGEMENT PRACTICES

Sarah Wynn[1#], Lucy Noon[1], Jack Scotney[1] James Masvongo[1], Jim Dimmock[1], Nadine Taylor[1], Pernille Thorbek[2], Sonja Braaker[3], Joanna Davies[4], Michael Grevé[5], Christian Bogen[5]

[1]RSK ADAS Ltd, Cambridge CB23 4NN, UK [#]Corresponding author: sarah.wynn@adas.co.uk [2]BASF Plc, Stockport SK1 3GG, UK [3]BASF France S.A.S., 21 Chemin de la Sauvegarde, 69130 Ecully, France [4]Syngenta, Bracknell RG42 6EY UK, [5]Bayer AG, Alfred-Nobel-Straße 50, 40789, Monheim, Germany

INTRODUCTION

Modern agriculture relies on **integrated crop management systems** combining:

- Mechanical practices (e.g., tillage, mowing, harvesting)
- Cultural practices (crop rotation, pruning, irrigation)
- Chemical inputs (fertilisation, plant protection products – PPPs)

While ecological risks of **PPP**s are highly regulated, impacts of **other routine farming practices** on **non-target terrestrial organisms (NTTOs)** are far less understood.

Key challenge:

Restricting one management tool often leads farmers to substitute with others – potentially shifting, not reducing, ecological impacts.

APPROACH

1. Crop management system characterisation

- **Wheat** (annual arable crop) assessed in United Kingdom, France, Poland
- **Apples** (perennial orchard crop) assessed in Poland, Italy
- Literature-based calendars validated by regional agronomy experts

2. Agroecological literature review

- **170 peer-reviewed studies synthesized**
- **Tillage, fertilisation, mowing and harvesting** impacts assessed on **earthworms, collembola, spiders, carabids, staphylinids, lepidopteran larvae and soil mites**

FINDINGS

Crop management is a system, not a set of isolated actions

- Practices interact across seasons and years
- Different tools are often applied for the same objective (e.g. weed control).
- Removing one tool (e.g. PPPs) often increases
  - Mechanical disturbance
  - Preventative interventions
- Alternative practices can cause **equal or greater NTTO impacts**

Tillage causes the strongest and most persistent impacts

- **Ploughing and deep tillage**
  - Consistently reduce abundance and biomass of soil-dwelling NTTOs
  - Cause direct mortality and habitat disruption
  - Mechanical disturbance (e.g. deep tillage) generally causes long-lasting population effects, exceeding recovery times typically considered acceptable for PPPs.
- **Reduced and no-till system**
  - Support higher biodiversity

Fertilisation effects depend on type and rate

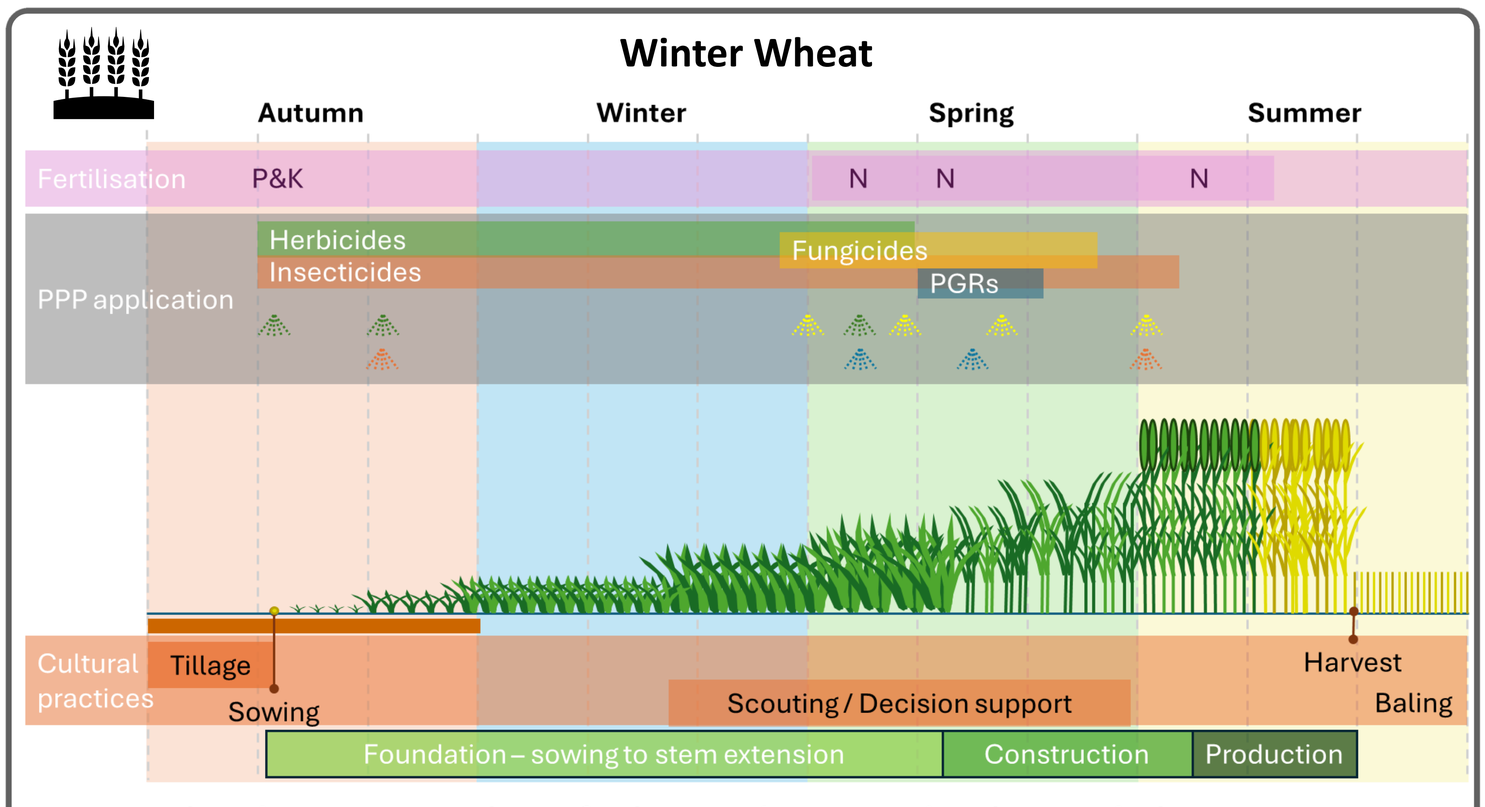
- **Organic fertilisers**
  - Generally positive for soil fauna
- **Manufactured fertilisers**
  - Low–moderate rates: mixed or neutral effects
  - High rates: negative impacts via toxicity and acidification
- Responses vary strongly by functional group

Mowing causes acute but short-term impacts

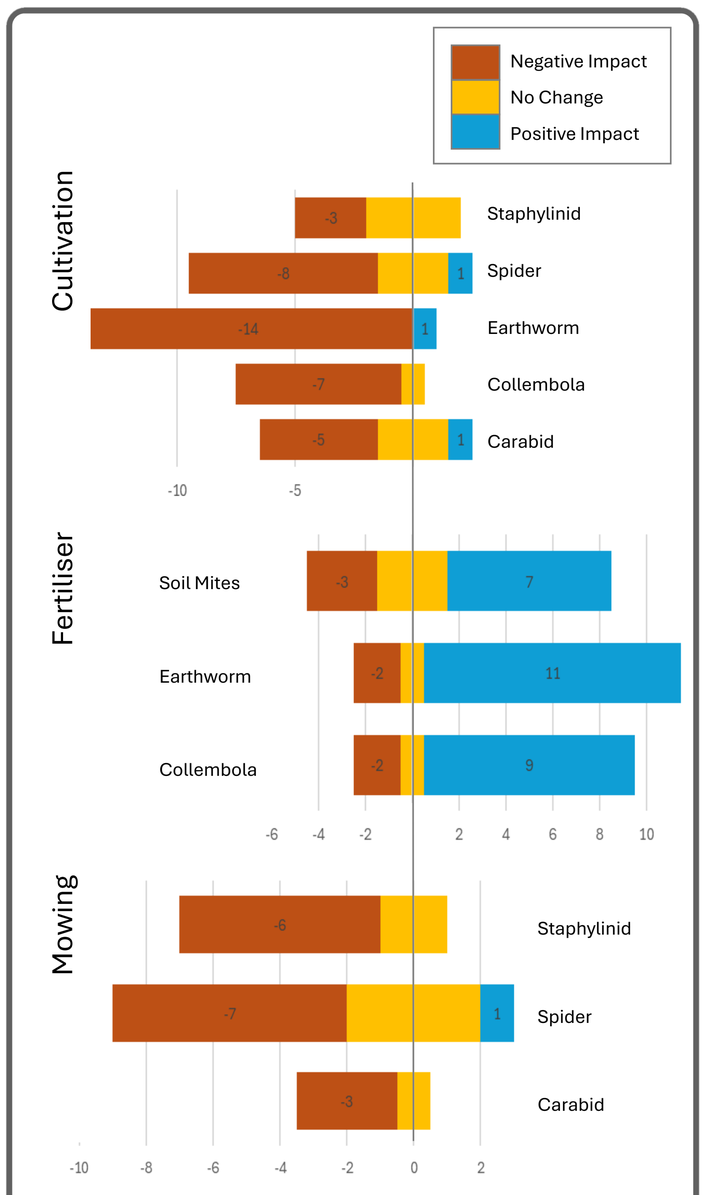
- High direct mortality for vegetation-dwelling NTTOs
  - Especially spiders and lepidopteran larvae
- Impacts strongly influenced by:
  - Timing
  - Frequency
  - Availability of refuge areas
- Patchy or delayed mowing reduces harm

Harvesting is a major evidence gap

- Very few direct studies across crops and taxa
- Likely negative effects inferred from:
  - Mowing (above-ground fauna)
  - Tillage analogies (root-crop harvesting)
- **Despite being unavoidable, harvesting remains under-studied**



Visual representation of winter wheat production cycle in Europe



Overview of numbers of studies showing positive, negative or no change to species abundance, biomass for each of three different agricultural practices on a range of NTTO taxa.

IMPLICATIONS FOR POLICY & RISK ASSESSMENT

- Environmental protection goals must:
  - Reflect realistic **farming systems**
  - Consider **substitution effects**
  - Integrate and be transparent about ecological dynamics in agricultural systems
- Focusing only on chemical risk may shift pressure onto:
  - Mechanical disturbance
  - Habitat disruption
- To achieve actual environmental protection, tool-specific impact mapping is needed
- A **whole-system perspective** is essential for proportionate regulation

CropLife EUROPE

ADAS

CEA
CAMBRIDGE ENVIRONMENTAL ASSESSMENTS