ADAS
Est. 1946

RESPONSIBLE
SUSTAINABLE
KNOWLEDGEABLE

Trends in Herbicide Resistance – The Unknown Unknowns

(November 2026)



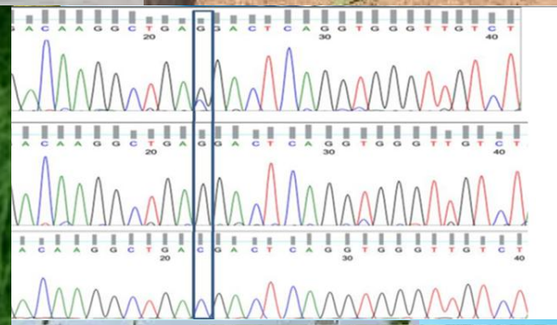














Trends in Herbicide Resistance

Knowns and Unknowns

From what we're sure of to what we can't yet see

Known Knowns

Long-standing resistance traits – national resistance testing results largely stable

Facts · evidence
established data

Known Unknowns

Confirmed resistance traits developing problems on-farm

Open questions · gaps
risks we can plan for

Unknown Unknowns

Emerging risk and future threats

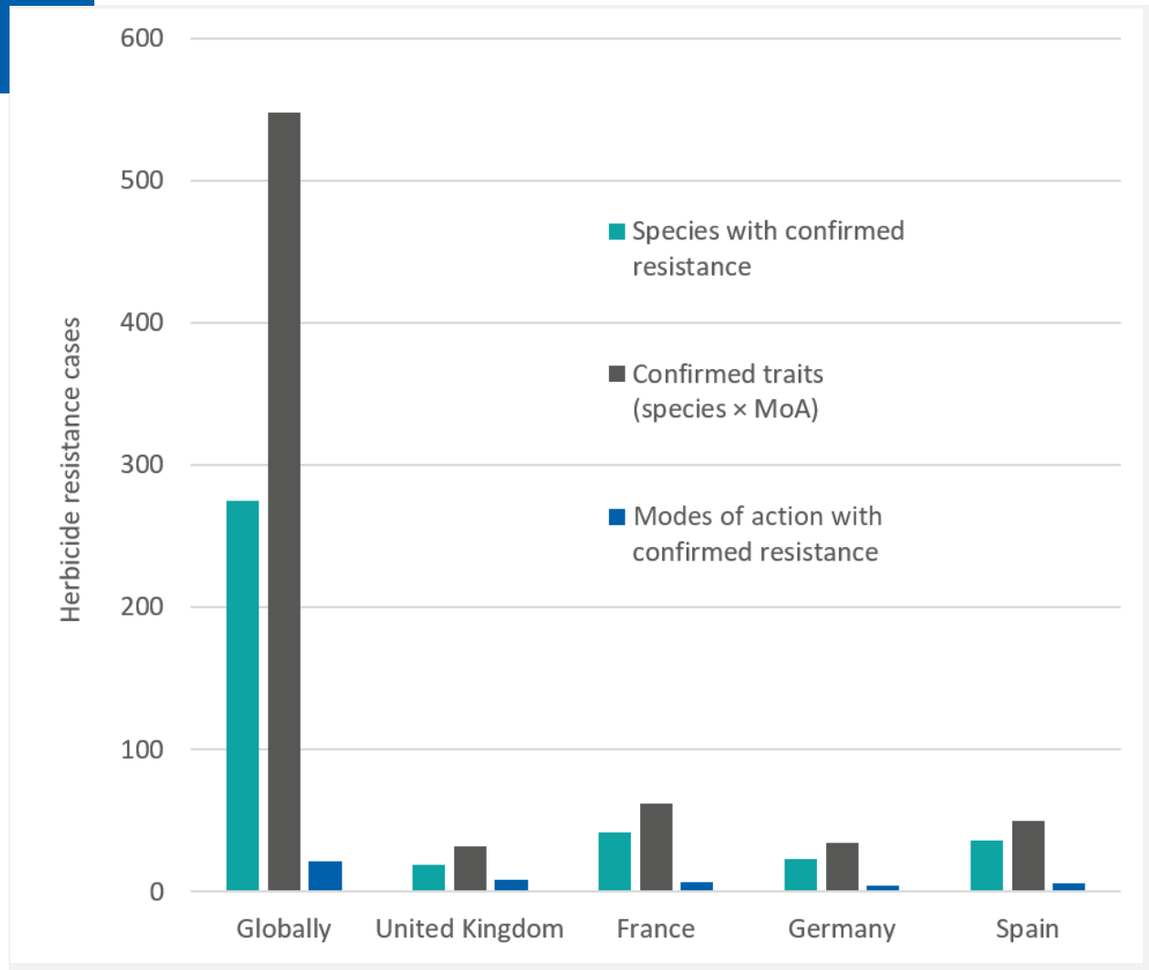
Blind spots
true surprises

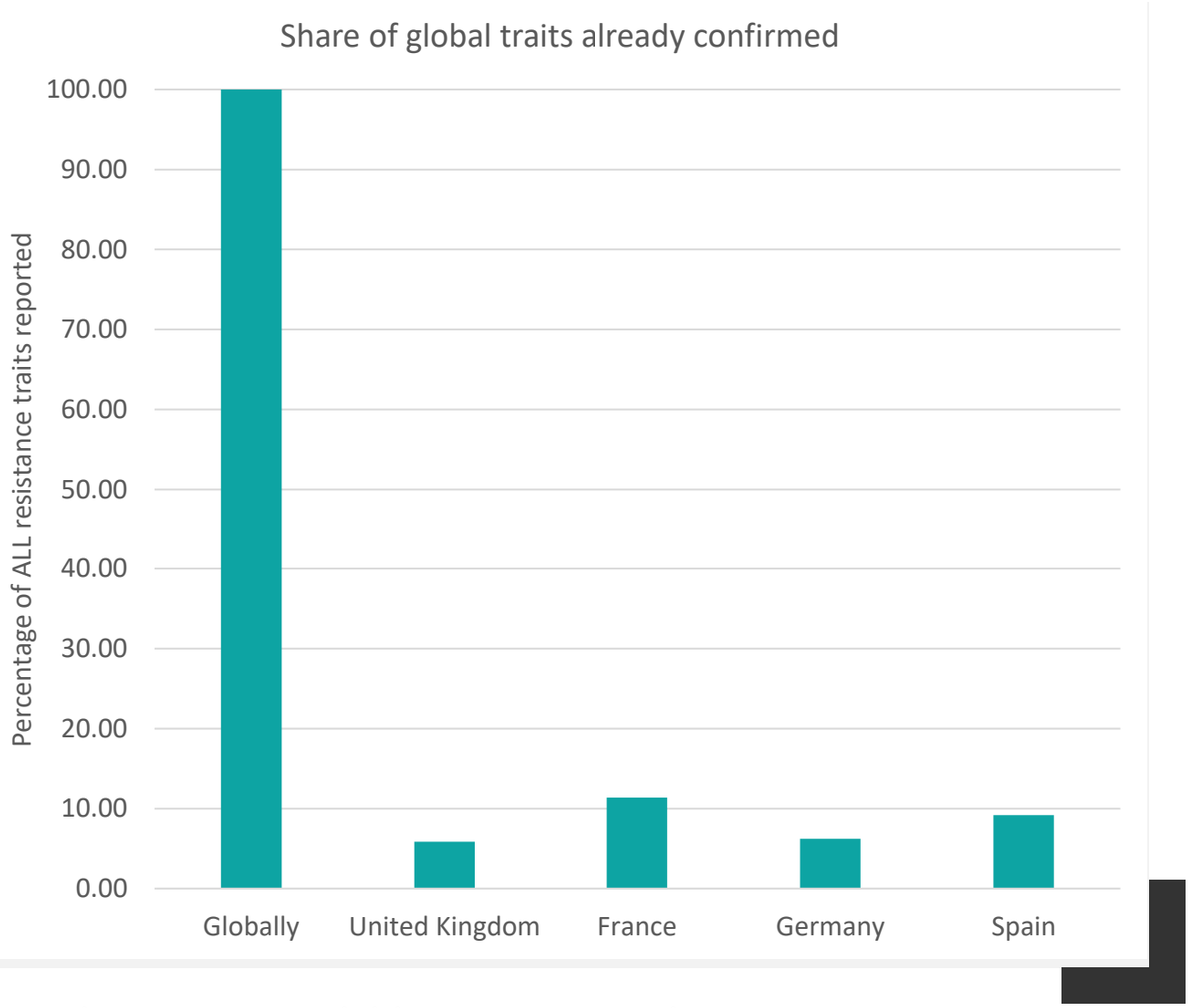
MORE CERTAIN → LESS VISIBLE

"There are known knowns… there are known unknowns… But there are also unknown unknowns…"

— Donald Rumsfeld, US Department of Defense briefing, 12 February 2002

The unknown-unknowns (emerging threats)





Heap, I. The International Herbicide-Resistant Weed Database. Online 2026. Available at www.weedscience.org.

The unknown-unknowns (emerging threats)

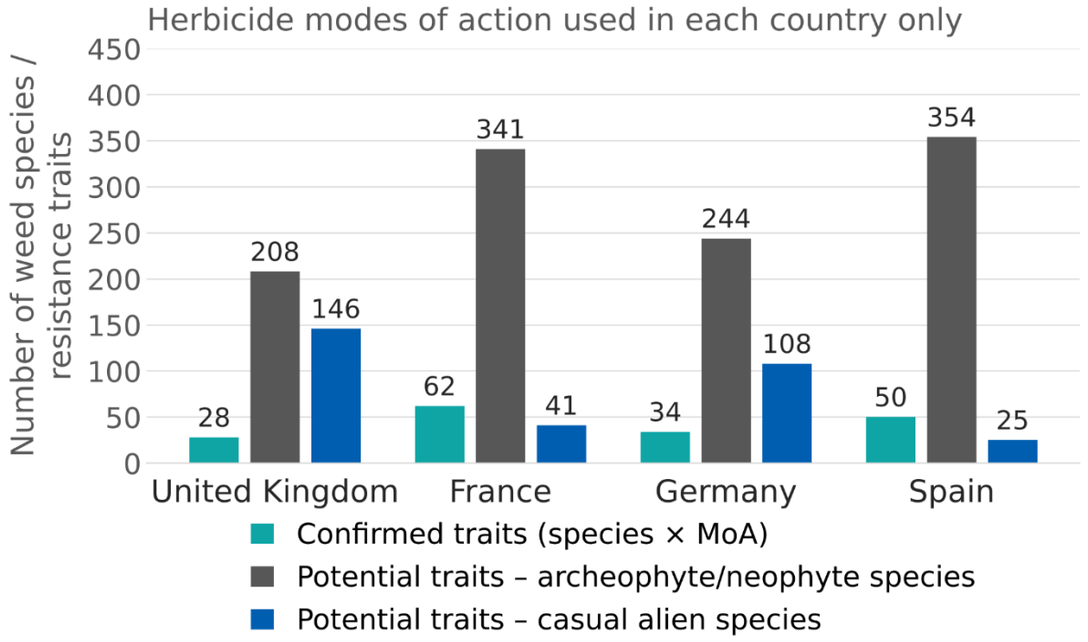
Can we narrow down the potential threats to GB?

- Focus on species with confirmed resistance to herbicide groups commonly used in GB
- Further refine on the basis of botanical survey records;
    - Species focus is on non-native alien weed species (as defined by Botanical recording as ‘Casual Aliens’) excluding those which are native to the UK (archeophytes) or well established (neophytes).

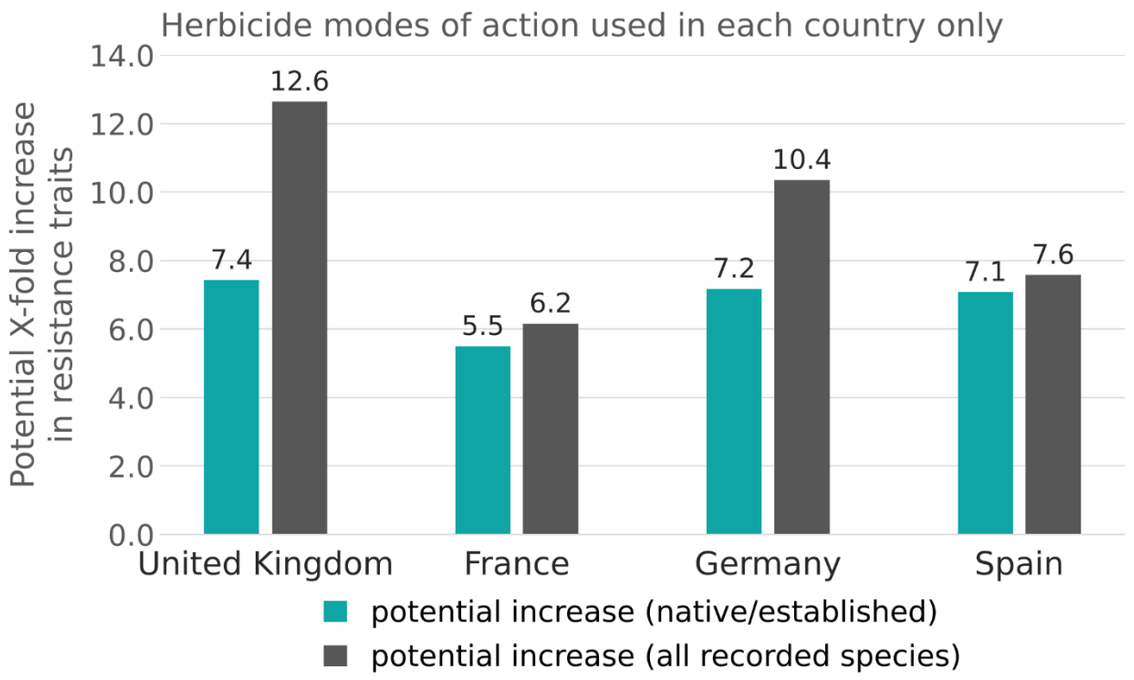
Combine data from;
Heap, I. (2024) The International Herbicide-Resistant Weed Database. https://www.weedscience.org/Home.aspx

GBIF: The Global Biodiversity Information Facility (year) What is GBIF?. Available from https://www.gbif.org/what-is-gbif (refined and cross-checked with additional data from BSBI Plant Atlas … Stroh, P. A., Humphrey, T. A., Burkmar, R. J., Pescott, O. L., Roy, D. B., & Walker, K. J. (Eds.). *BSBI Online Plant Atlas 2020*. Botanical Society of Britain and Ireland. BSBI Online Plant Atlas 2020. [1, 2])

The unknown-unknowns (emerging threats)



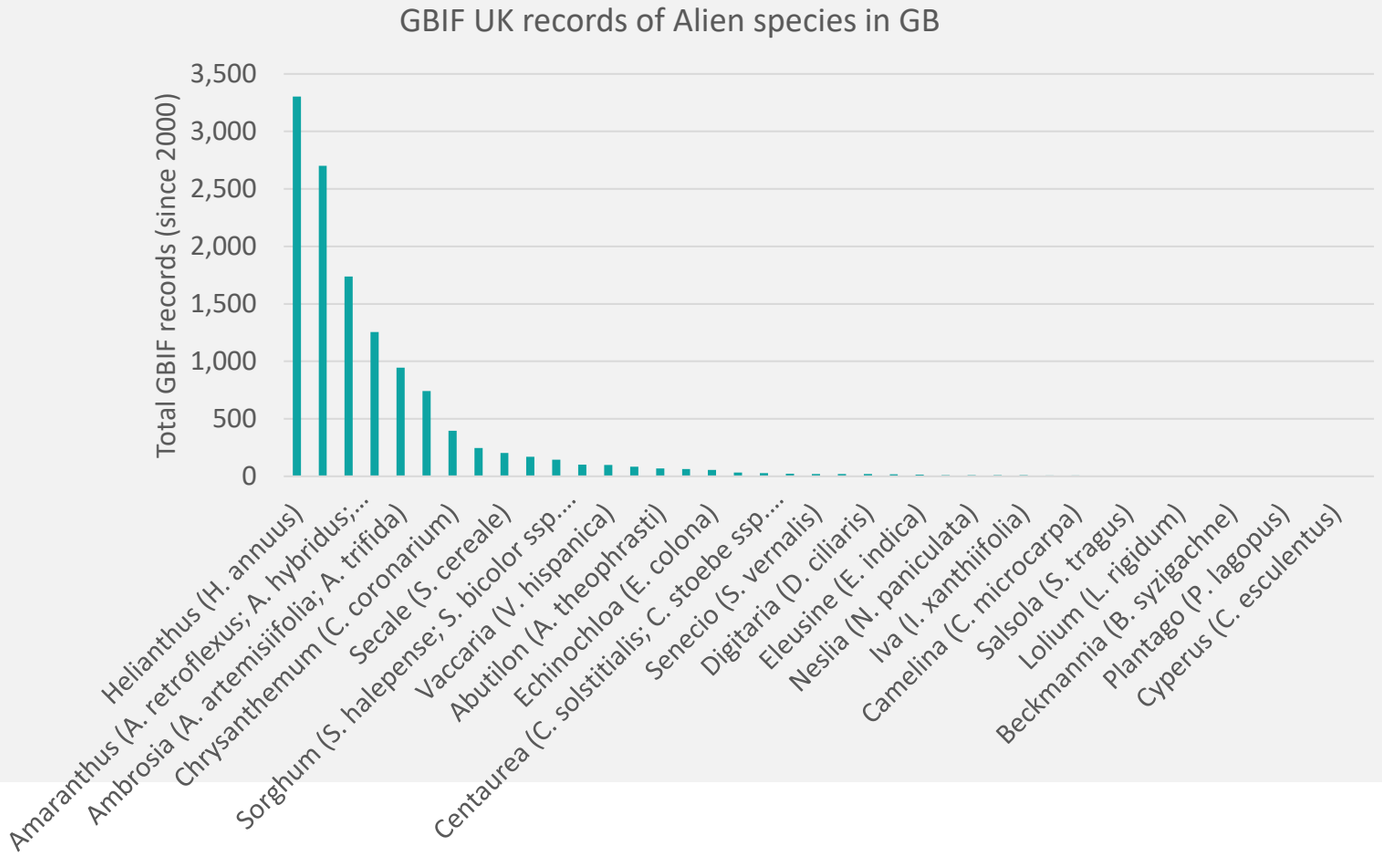
Only herbicide modes of action with at least one active substance approved in GB (UK) or the EU (France, Germany, Spain) are counted. Trait = species × mode of action.
Source: IHRWD (Heap, I.), weedscience.org, accessed 27 Oct 2026.



Only herbicide modes of action with at least one active substance approved in GB (UK) or the EU (France, Germany, Spain) are counted. Trait = species × mode of action.
Source: IHRWD (Heap, I.), weedscience.org, accessed 27 Oct 2026.

The unknown-unknowns (emerging threats)

A complete list of overlapping databases;
Casual Alien observation in GB / global resistance reports (MoA in use)



The unknown-unknowns (emerging threats)

A complete list of Top 10 ‘risk’ species on this basis.

Species group (species included)	No. species / taxa	Plant Atlas GB hectads 2000–2019 (combined)	GBIF UK records since 2000 (sum)
Datura (D. stramonium)	1	645	2,700
Amaranthus (A. retroflexus; A. hybridus; A. albus; A. cruentus; A. blitum; A. powellii; A. palmeri; A. viridis; A. spinosus)	9	581	1,739
Setaria (S. pumila; S. verticillata; S. adhaerens; S. faberi)	4	546	1,254
Ambrosia (A. artemisiifolia; A. trifida)	2	315	944
Raphanus (R. sativus)	1	338	743
Chrysanthemum (C. coronarium)	1	19	396
Panicum (P. capillare; P. dichotomiflorum)	2	110	246
Kochia (K. scoparia)	1	116	169
Sorghum (S. halepense; S. bicolor ssp. drummondii, S. bicolor)	3	95	145
Diplotaxis (D. erucoides)	1	22	101

Note: species cultivated as crops in GB are excluded

The unknown-unknowns (emerging threats)

Where this approach falls down

- Where species are now so widespread that Botanical surveys record them as **effectively naturalised species**;

Barnyard Grass (*Echinochloa crus-galli var. crus-galli*)

- Where ‘plant twitchers’ get excited and **over record** an interesting species;

There are more records of Fiveangled Dodder (*Cuscuta pentagona* 63 since 2000) that Wall Barley (*Hordeum murinum* Wall Barley Grass - 17)

- Where species **under recorded** but already emerging as a problem in arable land – species in arable fields are under-recorded;

Yellow nutsedge (*Cyperus esculentus*) – only 2 records in GBIF and none in Plant Atlas









The unknown-unknowns (emerging threats)

Where this approach falls down

- Where species are now so widespread that Botanical surveys record them as effectively naturalised species;

Barnyard Grass (*Echinochloa crus-galli var. crus-galli*)

- Where ‘plant twitchers’ get excited and over record an interesting species;

There are more records of Fiveangled Dodder (*Cuscuta pentago*
63 since 2000) that Wall Barley (*Hordeum murinum* Wal
Grass - 17)

- Where species are emergin arable land – species in arable fie corded;

Yellow nutsed *ientus*) – only 2 records in GBIF and none i



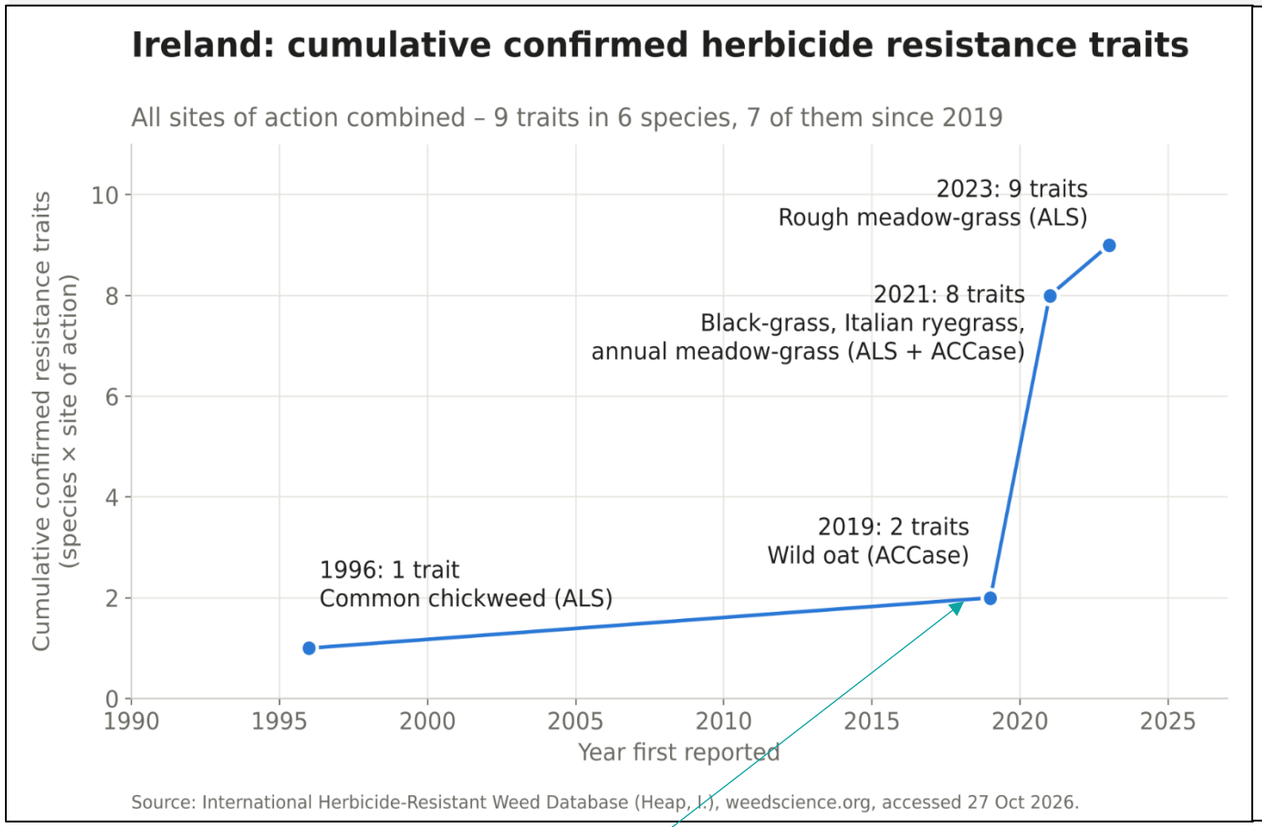




Despite the shortcomings – the stating point is to recognise the risk?

The unknown-unknowns (emerging threats)

The harder you look for emerging resistant traits the more you find.



ADAS has offered a molecular diagnostic test for 3 months and during that period;

Expanding the number and/or distribution of cases or for *C.album* finding a population in a new cropping system;

- 19 ALS resistant *P.rhoeas* populations
- An ALS resistant *T.inodorum* population
- An ALS resistant *S.asper* population
- A PS-II resistant *C.album* population

Potentially identifying new resistance traits (***these cases are potential and as-yet unconfirmed***);

- Multiple ALS resistant *P.annua* populations
- An ALS resistant *G.segetum* population

https://teagasc.ie/people/vijaya-bhaskar-av/

https://adas.co.uk/services/crop-diagnostics/rapid-leaf-testing/

The unknown-unknowns (emerging threats)

For unknown-unknowns – emerging threats and potential risks

- Surveillance for new traits needs to be active – details and context are less important than confirming the first case.
- It’s possible that apparently new cases could be identified at a high rate given the number of potential resistance traits in UK native and established species.
- The UK and other European countries are asleep at the wheel when is comes to biosecurity. Long before we adopt any new crops in response to climate change or succeed in encouraging different agronomic practises, we will already have the herbicide resistant weeds to make them impossible to manage.
- ‘Weeds’ are not ‘weeds’ – the same weed species can be present in multiple countries and continents where resistance has been identified zero tolerance for importation of weed seeds of even native species is needed.

Trends in Herbicide Resistance

Knowns and Unknowns

From what we're sure of to what we can't yet see

Known Knowns

There are resistance traits which have been known about for a long time and appear stable in resistance testing – what is needed is a better understanding of the effect of our approach to sampling to gauge the true prevalence

Known Unknowns

Move away from using averages and define risk scenarios better. What are the interacting roles of agronomy (IWM) and herbicide use? How do we best support and advise farmers and advisors?

Unknown Unknowns

We have the tools but we need a more active testing regime to respond to suspect cases better

Unknown Knowns

Is there information already out there to better understand trends in herbicide resistance?

MORE CERTAIN → LESS VISIBLE

"There are known knowns… there are known unknowns…
But there are also unknown unknowns — the ones we don't know we don't know."

— Donald Rumsfeld, US Department of Defense briefing, 12 February 2002