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# Herbicide resistance in our tillage fields

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Irish tillage farmers who visit Cereals or watch the UK farming press will be quite familiar with the concept of herbicide/weed resistance. The words 'blackgrass' and 'resistance' are seldom written about in isolation in British farming articles and herbicide resistant blackgrass has become the main weed control challenge for arable farmers there.

I recently spoke to the renowned Rothamsted weed researcher, Stephen Moss. He told me the story of how farmers in Wales believe they have 'imported' highly resistant blackgrass in straw taken in from arable farms in the east of England.

Thankfully blackgrass is uncommon in Ireland but its story serves as a warning for us all that resistance issues are very mobile and can very easily move from location to location. Because of this we need to be alert for unusual occurrences of weed problems and seek appropriate advice and clarification where they occur.

## ***What is herbicide resistance?***

There is some confusion amongst growers and advisors as to what exactly 'herbicide resistance' means. One definition that I think explains it well is: 'herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide that would normally be lethal to the wild type'. In other words the weed must survive (and produce progeny) after being treated with a rate of the herbicide that would have normally killed it.

The key point here is that resistant weeds are ones that have developed mechanisms to survive herbicide doses that would have killed that weed in previous years. Herbicide resistance is not poor control of weeds as a result of difficult spraying conditions, incorrect herbicide being applied etc.

Some confusion can also arise from the susceptibility charts included on herbicide labels. The term 'resistant' is often used on control charts to state which weeds are not controlled by a herbicide as determined by the manufacturing company. For example, cleavers has always been deemed to be resistant to Ally Max and that herbicide would never have been expected to control that weed. It is naturally resistant rather than having developed resistance.

## ***How can I spot resistance in the field?***

Herbicide resistance is rarely identified in practise when the problem is at low levels in a field. In my experience the best time to assess weed control is from the combine cab. If you see some weeds that were poorly controlled, or are occurring in patches (not coinciding with a sprayer run), it is time to be suspicious and you should talk to your advisor.

Guidelines drawn up by the Weed Resistance Action Group (WRAG) to help identify herbicide resistance suggest the following pointers:

- A gradual decline in control over several years.
- Healthy plants beside dead plants of the same species.
- Poor weed control leading to discrete weed patches.
- Poor control of one susceptible species when other susceptible species are well controlled.

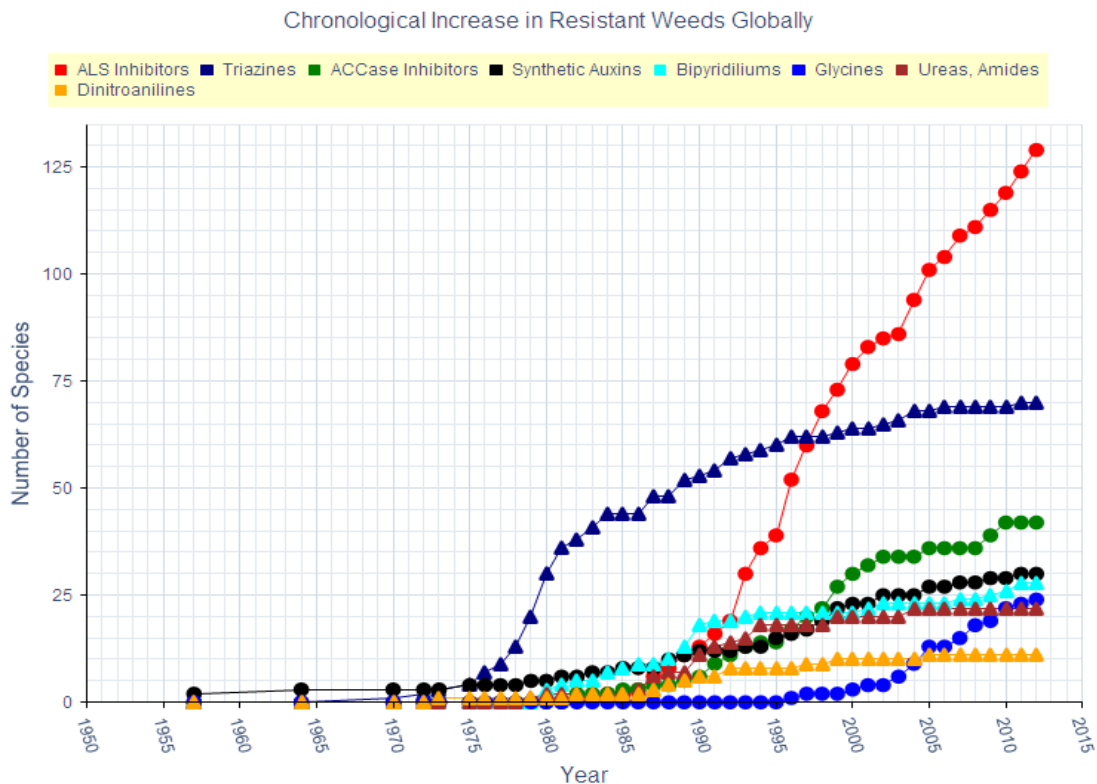
## How common is herbicide resistance worldwide?

There is no absolute answer to that question because it is not a static phenomenon. However, data on the subject is being continuously updated and Dr. Ian Heap, a weed researcher in the USA, edits an excellent website (<http://www.weedscience.org>) on the subject. According to this source there are currently 217 types of weed (129 broad-leaved weeds and 88 grass-weeds) that have developed resistance to 148 different herbicides worldwide.

Most of the scientifically proven resistant weed cases have occurred in the USA, Canada and Australia. This is hardly a surprise as herbicides are applied onto vast areas of crops, grown mainly in monoculture in a low yield scenario. Spain, France and Italy have the most reported cases of herbicide resistance in the EU but these are mainly in orchards and protected crops.

Resistance has been reported in all the main families of herbicides, as can be seen in Figure 1. This shows most recent problems occurring in the ALS inhibitor group, which includes the sulfonylurea herbicides.

Figure 1. Development of resistance in weeds to the different families of herbicides.



## ALS inhibitor herbicides

In Ireland, weed control in spring cereals, and a large area of winter cereals, is based on a family of herbicides known as ALS herbicides. Common names from this family include Ally Max, Cameo Max, Pacifica, Eagle etc. This family of herbicides has been very successful worldwide but it is also the grouping with the most reported cases of resistant weeds.

Luckily many of the ALS resistant weeds do not grow in Ireland but this should serve as a warning that these herbicides must be protected to ensure they are effective for a long time to come. ALS herbicide product labels have, for many years, stated that tank mixing with a product that has a different mode of action (e.g. hormone/fluroxypyr-based products etc.) is the best way to minimise resistance development. Normally we would expect that if a weed

develops resistance to one ALS herbicide (e.g. Ally etc), then it would be resistant to other ALS herbicides (e.g. Pacifica, Boxer etc). However, detailed genetic studies in the UK have identified that there are differences between the ALS-resistant weeds and how they are controlled ALS herbicides. Initial Teagasc studies have also found this to be the case amongst Irish samples of chickweed **but** in practical terms you need non-ALS herbicides for reliable control as you cannot tell (by looking) what genetic mutation is after occurring in your fields.

### ***Situation in Ireland - field experience***

There has been no systematic survey of herbicide resistance in Ireland so we can only go on reports from farmers and advisors. Due to our high proportion of spring crops, chickweed, marigold and poppy (to a lesser extent) are the most commonly reported weeds where herbicide resistance is suspected.

In fields where herbicide resistance has evolved, weed control is now primarily aimed at the control of the resistant weed(s). It is quite amazing how quickly a weed can become dominant in a field once it has a competitive advantage (herbicide resistance) over other weeds.

Of the grassweeds, wild oats is the one most commonly being suspected of herbicide resistance. But as well as resistance evolving in Ireland, there is also the high possibility that herbicide resistant weed seeds are being 'imported', given the movement of machinery, seed etc from other countries.

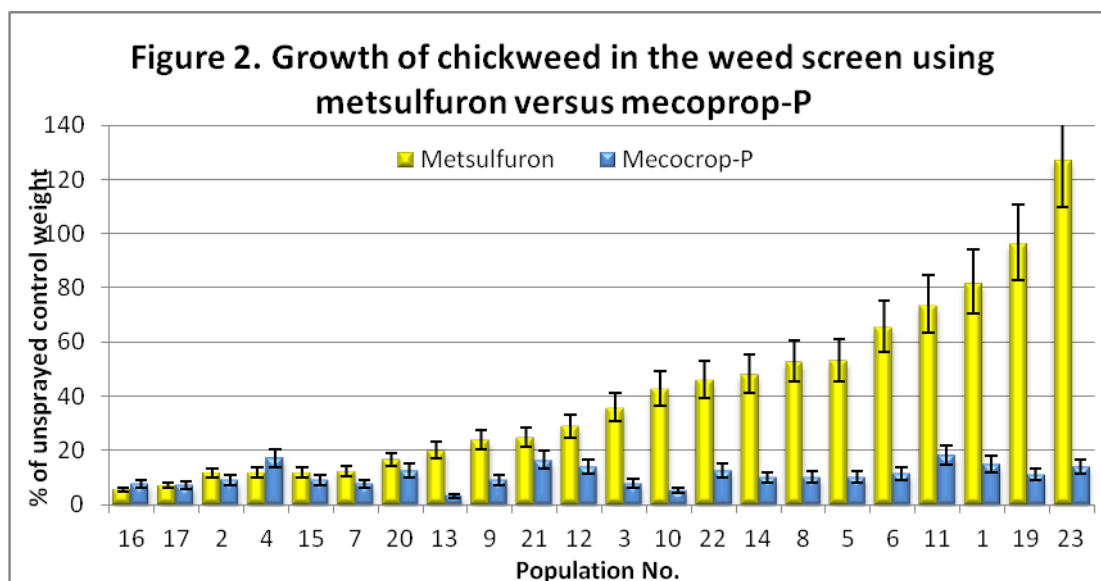
### ***Situation in Ireland – laboratory tests***

DuPont have confirmed resistance in ALS herbicides (Ally etc) to common chickweed, corn marigold and, recently, common poppy. In an effort to establish the extent of ALS resistant chickweed, Teagasc recently conducted a survey of 20 cereal fields from the main tillage areas.

Chickweed collected from 16 of the farms exhibited some reduced level of control with Ally, with seven farms meeting the criteria of having resistant types. Two other chickweed samples came from grassland fields and these were fully controlled by Ally, even at reduced rates.

All of the fields with reduced sensitivity to Ally had been in tillage for greater than 10 years and the farmers had been using ALS herbicides each year, albeit in conjunction with other non-ALS herbicides.

The full results from this screening test are shown in Figure 2. For this work the weight of 10 sprayed chickweed plants was divided by the weight of 10 unsprayed chickweed plants for each sample source. From figure 2 it is clear that there are large differences between the samples taken from the different fields in terms of the level of resistance found. And, importantly, all populations were fully controlled by CMPP (at full rate).



Other tests (not shown) confirmed that Fluroxypyr, IPU and Calaris gave good control of chickweed, irrespective of whether or not it was resistant to Ally. Remember that these tests were carried out in a glasshouse where temperatures were higher and spraying conditions were better than in most field situations.

### ***How can I control resistant weeds?***

Resistant weeds sometimes have a fitness penalty compared to their 'wild' types. Triazine (atrazine/simazine) resistant groundsel and black nightshade do not use sunshine as efficiently as their wild types, leaving the resistant types to grow more slowly and produce smaller plants. No measured differences have been reported for ALS-resistant chickweed, marigold or poppy but this is an area worthy of further investigation.

Cultural controls are becoming increasingly important in all weed management strategies. For example, corn marigold has been reduced from 148 plants/m<sup>2</sup> to 1 plant/m<sup>2</sup> by using a combination of liming, fallowing and herbicides. One four-year study in Canada found that by applying a two-thirds label rate of wild oat herbicide, while at the same time establishing a competitive crop, reduced the level of herbicide resistant wild oats over time.

Perhaps this is part of the reason that we have very few reported incidences of herbicide resistant wild oats (and grassweeds) in Ireland, as compared to cereal growing in Canada, we manage all crops to produce big canopies and high yields.

For the majority of tillage farmers an effective herbicide is still the most desired solution. So taking the three ALS-resistant weeds, what are the solutions? From the Teagasc glasshouse studies we see no cross-resistance with other herbicide groups and CMPP and Fluroxypyr are still fully effective against Chickweed.

I suspect that spraying conditions (particularly temperature) need to be close to optimum for best control when using CMPP or Fluroxypyr against chickweed. Remember, the majority of the herbicide work was being done by the ALS herbicide up to now. In the case of marigold, preliminary Teagasc tests showed that loxynil/Bromoxynil (Oxytril etc) gave full control (even at low rates). But clorpyralid (Shield etc) needed to be applied at full rates to achieve effective control of Marigold. For poppy control, the UK trials have shown that MCPA and ioxynil+bromoxynil (Oxytril etc) are still fully effective where ALS-resistance has been confirmed.

#### **CAPTION:**

*Plants from the different chickweed sources were all killed where the mecoprop-P (CMPP-P) was applied but Ally failed to kill the resistant types (centre bottom).*

## ***What weeds will become resistant in the future?***

To answer that question, a comprehensive review of broad-leaved weed resistance was commissioned in the UK by DEFRA. In summary it found that weeds that produce high numbers of seeds which can reproduce more than once per season pose the highest risk of herbicide resistance. If herbicide resistance has already been found in a similar situation (crop, climate, etc) this also should act as a warning.

The most important chemical factors include the herbicide mode of action, mode of use (i.e. alone or in mixtures and sequences, or multiple applications in a season), its intrinsic activity and its residual activity. Cultural control continues to have a major role to play in herbicide resistance management strategies.

Table 1 contains a brief summary of some common Irish tillage weeds and whether herbicide resistance has been confirmed (by laboratory test). There are many other cases (e.g. annual meadow grass in USA golf courses) that are unlikely to transfer to Irish tillage fields but some of the examples could occur here in the future.

**Table 1. Some common Irish weeds and their herbicide resistance status elsewhere.**

<b><u>Weed</u></b>	<b><u>Resistance confirmed</u></b>	<b><u>Crop</u></b>	<b><u>Herbicide family concerned</u></b>	<b><u>Example Trade name</u></b>
Charlock	Yes - Spain	Cereals	Sulfonylureas; Synthetic Auxins	Cameo; 2,4-D
Common Chickweed	Yes – Ireland; Yes - UK	Cereals; Grassland	Sulfonylureas; Synthetic Auxins	Ally; Duplosan
Common Poppy	Yes – Ireland; Yes - Spain	Cereals	Sulfonylureas; Synthetic Auxins	Ally; 2,4-D
Corn Marigold	Yes - Ireland	Cereals	Sulfonylureas	Ally
Fat Hen	Yes – Belgium; Yes - New Zealand	Beet; Maize	Triazinone; Synthetic Auxins	Goltix; Dicamba
Groundsel	Yes - UK	Vegetables	Triazinone	Goltix
Mayweed	Yes - UK	Cereals	Sulfonylureas	Ally
Wild Oats	Yes – UK; Suspected - Ireland	Cereals	ACCase inhibitors	Puma Extra

## ***Key points***

- ☞ ***Herbicide resistance is a real issue in global agriculture and we are not immune in Ireland***
- ☞ ***'Real' resistance has already been found in chickweed, corn marigold and poppy.***
- ☞ ***Growers should treat patches of uncontrolled weeds as suspicious and have the problem checked out.***
- ☞ ***Watch crops following spraying SU herbicides as neighbouring weeds could be killed or survive depending on their status.***