Efficacy Crop Guide 02- Grassland

Interpretation of efficacy data requirements for the authorisation of a plant protection product in agricultural grassland for grazing or forage (3GRLC) in the UK.

Contents

Introduction

This document is intended to assist applicants in addressing and interpreting current efficacy data requirements, and relevant accompanying EPPO standards, with specific focus on grassland. It provides supplementary information on UK agronomy, including relevant UK targets and trials numbers, if applying for a UK-only authorisation.

All trials should be carried out under Good Experimental Practice (GEP) and using all relevant general EPPO Standards. Effectiveness and selectivity trials should be performed according to the EPPO standard 'PP 1/181 - Conduct and reporting of efficacy evaluation trials including good experimental practice' (available from the EPPO website.

All tests should be carried out with the formulation of the product intended for use. If other formulations were used such data may still be used to support the proposed formulation, however bridging data or a sound scientific justification should be supplied to demonstrate comparability of the formulations and allow bridging between formulations. Further details on supporting formulation changes can be found in EPPO 'PP 1/307 Efficacy considerations and data generation when making changes to the chemical composition or formulation type of plant protection products'.

Note: This guide does not cover grass seed crops i.e. grass grown for seed production.

Area of grassland in the UK

In the UK in 2018 there were approximately 17.5 million hectares of utilised agricultural land. Of this 71% was used for grassland and 27% used for other crops, highlighting the importance of grassland in the UK landscape. (Source: Agricultural Census).

Grassland usage

Grassland is used predominantly for the grazing of livestock or the production of hay and silage for feeding livestock, typically over-winter. Hay used to be the traditional method of forage conservation in the UK but has been superseded by silage in recent years. In 1970 about 80% of the grass conserved was as hay but this had fallen to less than 30% by 1990.

Hay is grass that has been cut and dried. Grass is cut typically as soon as the grass has started to set seed but before the seed has dropped. This may be as early as mid-June to early July. If the hay is left to stand past being" ready" then its nutritive value will fall quite quickly, partly because of seed shedding and partly because of mobile nutrients, such as nitrogen being taken back into the base of the plant, where it is stored for the following year. Late cut hay will be of lesser value for productive stock. Hay is generally more palatable than silage due to the high sugar content and the reduced protein breakdown. The breakdown of hay in the animal also results in a more synchronised release of energy and protein. Its main disadvantage is its reliance on having 5 or 6 days of fine weather, something which cannot normally be guaranteed in the UK. In most years only 1 crop of hay is possible from a single field due to the stage at which the grass is harvested.

Silage is a forage crop that has been preserved in acid. In a natural fermentation the acid is produced by bacteria present on the crop that, in the absence of air, convert plant sugars mainly into lactic acid. Grass may be ensiled in bulk (with the grass covered to exclude air) or in wrapped bales. Silage can also be made from forage maize and other crops such as wheat.

A first cut grass silage is generally taken around 15 May when 50% of the sward is at the point of ear emergence. As the grass develops the ear stem, it goes through a process of increased lignification. This reduces the digestibility of the whole plant and so leads to a decline in energy. As a rule, digestibility, measured in D-value, falls by 0.5 D-value a day from when grass starts to bulk up. But this will be influenced by the species of grass, the heading date of grasses in the mixture, local climate and clover content of the sward - as clover digestibility reduces more slowly than grass. When grass is at its optimum quality in the field before first cut it will have an energy content of about 12.8MJ/kg Dry Matter. There may be a second cut of silage taken from the same field. The time between first and second cut will have most impact on second cut quality, but this will depend on other factors, including maturity class of species and varieties in the sward, clover content and nitrogen applications. After cutting grass is wilted as quickly as possible, and certainly for no longer than 48 hours to reduce moisture content from approximately 80% to 75% moisture for ensiling in a clamp, or 55-65 % for bales.

Types of grassland

Grassland includes temporary and permanent grasslands and rough grazing.

A significant proportion of UK grassland is permanent pasture. In terms of broad definitions;

Permanent pastures

Permanent pastures are defined as being laid down to grass for a period of more than five years and not been ploughed for other crops during that time. It's typically used for grazing or occasional cutting. Generally, the quality of grazing on permanent pasture is significantly lower than that of shorter-term leys because the grass is older. On average, permanent pasture will consist of no more than 50% of originally sown species, the remaining percentage being made up of weed species such as annual meadow grass.

Temporary pastures or leys

Temporary pastures or leys are defined as being laid down to grass, clover, herbs etc for a single season or a limited number of years. It's typically used for forage and replaced on a regular basis. As a rule, shorter term leys are higher yielding while longer term leys may give lower yields but have greater longevity.

Short Term Ley

The typical lifespan of a short-term ley is 1-2 years. Short term leys are generally high yielding and used for conserved forage such as silage or haylage.

Medium Term Ley

A medium-term ley lasts 3-4 years. It's chosen for cutting only, or for dual purpose cutting and/or grazing, where the compromise of a higher yield is required, together with a longer lasting ley.

Long Term Ley

Long term leys, lasting 4-5 years, are chosen if the ley is to be used for grazing only, but where a better quality than permanent pasture is required.

'Rough grazing' is typically considered as low yielding permanent grassland, usually on low quality soil, for example on hilly land and at high altitudes, usually unimproved by fertiliser, cultivation, reseeding or drainage. These areas can normally be used only for extensive grazing and are normally not mown or are mown in an extensive manner; they cannot support a large density of animals.

In terms of the CRD Crop Definitions (2017) these different types all fall under the same grouping;

***"Grassland:** Land grown for grass production includes short and long-term grass leys and permanent pasture, which may be grazed and /or cut for subsequent animal consumption. Includes use on newly sown leys and moorland for grazing (unless specifically excluded on the label/authorisation).*

Excludes use on amenity grass (see entries for 'Amenity grassland' and 'Managed amenity turf'"

Grass growth

After sowing grass seed the seedling germinates and the first leaf appears. Each new leaf grows up through the last one. While this looks like a stem, it is not the true stem which in true grasses is at ground level and escapes the grazing animal. It will stay at ground level while the plant remains vegetative. The seedling plant develops to produce 5-6 live leaves. This reduces to a constant number of live leaves, for the main shoot and each tiller[1] (potential new plant) produced, depending on the species. Ryegrass will have 3 live leaves on the main shoot and each tiller. Leaves continue to be produced, but as each new leaf appears the oldest one dies. The rate of appearance varies between species, but ryegrass leaves typically appear every 11 days, so each leaf lives for 33 days.

Grass plants produce tillers. Tillering continues until all the gaps have been filled between plants and they need to compete for nutrients, water and light nutrients. Older plants become detached from newer tillers and they eventually die, each tiller living for approximately 1 year. The size and number of tillers/m2 will vary depending on management. A ryegrass sward under infrequent defoliation, e.g. a rotational dairy system, will have around 10,000 large tillers/m^2 but a sward intensively grazed at 4 cm by sheep could have 40,000 tillers/m^2. Although the structures of these swards are

[1] A tiller is a stem produced by grass plants, and refers to all shoots that grow after the initial parent shoot grows from a seed. Tillers are segmented, each segment possessing its own two-part leaf. They are involved in vegetative propagation and, in some cases, also seed production.

different the total dry matter production is similar.

Most grasses must experience winter conditions of low temperatures and short-day lengths to trigger the mechanisms for seed production. Early flowering ryegrasses are sensitive to March/April temperatures and late heading varieties to April/May temperatures. Once the plant produces the true reproductive stem the production of leaves ceases. For grazed grass (unlike grass for hay or silage) it is important to maintain leaf levels throughout the season and prevent grass from seeding. Poorly managed swards can fall to 60% leaf during the reproductive (stemmy) period compared to well managed swards (grazed to 4.0 – 4.5 cm) which will contain high (80%+) leaf levels in the mid-grazing horizon (4 to 10 cm).

Re-seeding grassland

Well-managed grass is the cheapest feed for ruminant livestock such as cattle and sheep. Renewing pastures regularly is important to maximise productivity and maintain feed quality although it is costly at £400–700 per hectare. Re-seeding may be considered if grass productivity has fallen significantly, less than 60% of the original sown species remain, there is significant evidence of soil compaction or there are high levels of weeds present such as thistles, docks, buttercups, common chickweed and nettles.

Re-seeding pastures generally takes place in the autumn (August to October) or the spring (March to May). A break crop, like stubble turnips or kale, can be used to avoid a grass-to-grass reseed. It can help to break any pest cycles and also provides useful additional feed if utilised well.

Choosing the correct grass seed mixture is important. Most reseeds are a mixture of diploid and tetraploid perennial ryegrasses. Tetraploids have larger seeds and leaves and tend to establish quickly. They are also more able to compete when over-seeding pastures. They also have a more upright growth habit and are suited to drier growing conditions. Diploids are more persistent and tiller more freely, producing denser swards than tetraploids. They are generally better suited to wetter growing conditions. However, other types of ryegrass and species such as clover, cocksfoot and timothy may have a role to play in certain situations. Each type of grass has different growth and quality characteristics. The average seed rate is 35 kg seed per hectare.

Before re-seeding, herbicides may be applied to the existing sward to remove any existing weeds and reduce competition for the new ley.

The primary aim of any re-seed cultivations is to provide the perfect environment for a seed to germinate. This means good seed-to-soil contact, a fine seedbed with good soil structure which is weed-free and a seedbed which retains enough moisture for seed germination.

A newly sown sward takes about 11 months to fully establish. During this time, it is important that the sward is encouraged to tiller as much as possible and is protected from any damage.

Once the grass has germinated and the third or fourth leaf appears on the main tiller, daughter tillers will start to appear. These will eventually form leaves and roots and will allow the plant to spread and the sward to thicken.

An established perennial ryegrass sward typically has 300–400 plants/m^2 and typically contains 5,000–7,000 tillers/m^2. This helps to create a dense sward, minimising soil damage and reducing space available for weed infestation.

The tillering process in new swards is strongly encouraged by grazing. Grazing removes the existing leaf and encourages a new generation of tillers to emerge at the base of the sward.

New re-seeds are grazed typically at the two-leaf stage or when the grass has produced about 2,200–2,500 kg DM/ha. Sheep or youngstock tend to be used for the first grazing to minimise any potential soil compaction, particularly in wet conditions. Subsequent grazing occurs when the grass is at 6-7 cm.

New re-seeds should be grazed off well before first winter (<4 cm) to encourage tillering. Cutting for silage should be avoided in the first 6 months as it does not encourage the sward to tiller.

An alternative method of grassland establishment is to undersow it to a cereal crop. This means that a ley is already well established immediately after cereal harvest.

If undersowing, the seed rate for the cereal crop is reduced to allow space for the young grass seedlings to develop. Barley is usually chosen as it is a more open crop than wheat. If drilling spring barley in February, then it is best to wait and drill the grass generally in late March. If drilling the barley in late March, then the grass can be sown (separately) the same day.

Addressing Efficacy Plant Protection Product Data Requirements (IIIA 6)

(IIIA 6.1) Preliminary data

Results of preliminary tests and early screening studies can provide useful information on, for example, dose justification and evidence of safety to potential following crops.

(IIIA 6.2) Minimum Effective Dose

Trials should be conducted in accordance with EPPO standard 'PP 1/225 - *Minimum effective dose'*. Minimum effective dose trials should be conducted to demonstrate that the proposed dose is justified for the chosen representative use(s). Most of the data should be generated where target pressure is highest, but a proportion of trials should still include areas of more variable target pressure. A justification for the number of applications applied may also be required if multiple applications are proposed. Minimum effective dose should be based on the key targets or representatives of them and these are presented below.

(IIIA 6.2) Effectiveness

Location of trials

As a general principle, data generated from outside of the UK may be used to support a UK authorisation. The acceptability of the data will be dependent on detailed evidence and an appropriate case on the comparability to the UK of agricultural, plant health and environmental (including climatic) conditions, relevant to the use of the product, in the reference country. EPPO standard 'PP 1/241 - *Guidance on Comparable Climates*', provides more detail on this approach. (In addition, EPPO standard 'PP 1/269 - *Comparable climates on a global level*' discusses the climatic relevance of data generated outside the EPPO region. This will be relevant as part of an appropriate case, which should follow the principles above and additionally consider the conduct of trials in relation to EPPO standards).

Further, EPPO standard 'PP 1/278 - *Principles of zonal data production and evaluation*' discusses the various factors involved in considering trials planning on a more regional basis and ensuring all relevant conditions are tested. This may also be useful in considering the reasoned arguments on the relevance of data to the UK, as well as if an authorisation in the UK may be sought as part of a wider, regional regulatory submission.).

Number of trials

EPPO standard 'PP 1/226 - *Number of efficacy trials'* indicates that for authorization in a single country/climatic zone, 6 to 15 fully supportive results are required over two years for each major use. Current UK requirements for demonstration of efficacy indicate that in general 10 fully supportive trials are sufficient for a use against a major target species on a major crop

Where a major target is appropriately supported, it may be possible to have a reduced number of trials for minor targets (see tables below for specific targets); typically, a

minimum of 3 supportive trials which may be conducted in a single season. If, however, relevant major targets have not been supported then the primary target for that product should as a minimum be supported by 10 trials results (over two seasons).

EPPO 'PP 1/226' also states that "In some situations, there may be the opportunity to reduce the number of trials done, and a case may be made for this as follows". It then describes the situations where a reduced number of trials may be acceptable.

(As indicated above, if a UK authorisation is sought as part of a wider, regional regulatory submission, EPPO standard 'PP 1/278 - *Principles of zonal data production and evaluation*' may be relevant when considering trials numbers).

Trials reporting

Trials should be conducted in accordance with EPPO standards 'PP 1/181 *Conduct and reporting of efficacy evaluation trials including good experimental practice'* and 'PP 1/152 - *Design and analysis of efficacy evaluation trials'*. The key information should be presented in appropriate summary tables which should include (but is not exclusive to):

For all product types: crop growth stage (BBCH) at time of application and calendar timing range; pest population levels at time of application and at each assessment; number of trials; mean percentage control/effect and the range of minimum and maximum levels, for both the test product and also for the reference products, at each assessment timing.

For weeds: weed species; weed growth stage (BBCH) at time of application and time of assessment; weed numbers at application (percentage ground cover or number/m^2).

Results should only be included from trials conducted in accordance with EPPO Standards and where there are agronomically relevant pest populations present. It is not appropriate to have a prescriptive list of 'minimum populations' for all possible target organisms but indicative levels for weeds, pests and diseases are given below:

Target	**Minimum population**
Weeds	Broadleaved weeds - 5 plants/m^2 Major weeds (eg.cleavers) higher population Grass weeds – head count -20/m^2
Diseases	5% plants infected or 5% leaf area
Pests	Specific agronomic threshold (or case) – provide appropriate published reference where possible

Number of trials for UK relevant pests

In determining the number of trials required for each target, the following should be considered, relating to the major or minor status of that pest/weed/disease in the UK. In addition, reference should be made to the UK differential labelling scheme, outlining appropriate label claims supported by the effectiveness trials data. (For further information, see 'Efficacy assessments: UK product labelling and National issues/addenda on the CRD website at the following link:

https://www.hse.gov.uk/pesticides/pesticides-registration/efficacy-guides/index.htm)

Insect Pests of Grassland

Newly-sown pastures are more vulnerable to attack by pests than established grassland. Table 1 shows those pests of grassland which are considered to be of importance to the UK and which are major and minor to help assist in planning trials.

Table 1 – Pests of grassland.

Pest group	**Major**	**Minor**
Diptera (flies)	*Frit fly, Oscinella frit (OSCIFR)*	
Diptera (flies)	*Leatherjackets, Tipula sp. (TIPULA)*	
Beetles	*Chafer grubs (MELOME)*	Cutworm (Agrostis spp) (AGSSS)
Beetles		Wireworms (Agriotes spp.) (AGRISP)
Slugs	*Deroceras reticulatum (DERORE) and other Deroceras species; Arion hortensis (ARIOHO), A. distinctus (ARIODI) and other Arion species*	

Relevant supporting data may be available from other appropriate crops that could reduce the number of grassland trials results. For example, it is possible to extrapolate support for Frit fly or leather jackets with data in cereals or for chafer grubs in turf. For the generic pests cutworm and wireworm refer to the EPPO Minor Use Table on soil pests for extrapolations. For advice on the conduct of trials for slugs or possible extrapolations refer to EPPO standard 'PP 1/95 – *Slugs'*. Frit fly and slugs are a problem during establishment only (up to BBCH 14), and leatherjackets in established pastures.

Where clover is present pest damage is primarily from slugs and sitona weevils (SITNSP) but any damage caused is generally not considered to be of agronomic importance.

Principles of extrapolation for pests

As stated above, for major pests, a minimum of 10 fully supportive results are required, with a minimum of 3 results for minor species unless a case for extrapolation has been made as described below.

It may be possible to reduce the number of required supportive results, or directly extrapolate from an existing data set, provided an appropriate reasoned case is made. This may be a relevant approach either for the same species on a different host crop; or extrapolating between closely related species. The reasoned case must consider all relevant factors, including sufficient information on the pest biology and crop agronomy.

Diseases of Grassland

Crown rust, *Drechslera* and powdery mildew are the most common fungal diseases found on the leaves of all grass species. Serious disease outbreaks in grassland can affect yield and alter sward quality and composition (Ref: AHDB - Grass+ factsheet 10 - grassland pests and diseases, 2012) and it is estimated that disease can cause crop losses of over 1t DM/ha over a three-year period (AHDB, 2017). However increasingly grass varieties are available which are resistant to these diseases and fungicides are not commonly used.

For example, the Pesticide Usage Survey Report 279 (2017) indicates that the use of fungicides on grassland and fodder crops accounted for 3% of the total area treated, with undersown new leys and other crops for stock feeding (which includes cereals grown for whole crop silage) accounting for 65% of all usage. For both crop groups fungicide usage was targeted to control diseases within cereal crops, either those being grown as a nurse crop to an undersown new ley or to those being grown for whole crop silage.

Therefore for a claim of effectiveness against mildew and crown rust in grassland extrapolation of effectiveness claims from corresponding authorised uses on cereals would be sufficient. Furthermore extrapolation of claims for the control of *Drechslera* would be possible from amenity grassland/managed amenity turf. The reasoned case must consider all relevant factors, including sufficient information on the disease and crop agronomy.

Where extrapolation is not possible applicants should contact CRD for more detailed advice on data requirements.

Weeds of Grassland

In established grassland weeds can reduce the productivity of the sward if grazed by livestock and can also decrease the yield and quality of any conserved forage. In addition, there are some weed species which, if consumed, are poisonous to livestock e.g. ragwort, creeping buttercup and a number which are subject to regulation under the ‘Weeds Act (1959)’. The ‘Weeds Act (1959)’ (the Act) allows the Secretary of State for Environment, Food and Rural Affairs to take statutory action to control the spread of the following five injurious (harmful) weeds;

Spear thistle (*Cirsium vulgare (Savi) Ten*.), (CIRVU)

Creeping or field thistle *(Cirsium arvense (L.) Scop.),* (CIRAR)

Curled dock *(Rumex crispus (L.),* (RUMCR)

Broad-leaved dock *(Rumex obtusifolius (L.)),* (RUMOB) and

Ragwort (*Senecio jacobaea (L)* now *Jacobaea vulgaris)* (SENVU)

Where weed populations develop to a large extent, swards may need to be re-seeded. This is costly to undertake and controlling weeds in these re-seeds is especially important to ensure that the new grass establishes quickly, without significant weed competition.

Table 2 shows those weeds of established agricultural grassland and newly sown grassland which are of importance in the UK and which are major and minor to help assist in planning trials.

Table 2 – Weeds of grassland.

MAJOR WEED SPECIES (Please refer to EPPO PP 1/61 '*Weeds in grassland*' for details on trials conduct).	
Newly sown grassland	
Major	**Minor**
Common chickweed (*Stellaria media)* (STEME)	Fat hen (*Chenopodium album*) (CHEAL)
Dock species (*Rumex* spp) (RUMSS)	Charlock (*Sinapsis arvensis)* (SINAR)
Mayweeds (*Matricaria* spp.) (1MATG)	Redshank (*Persicaria maculosa)* (POLPE)
Established grassland	
Major	**Minor**
Brambles (*Rubus fruticosus*) (RUBFR)	Dandelion (*Taraxacum officinale*) (TAROF)
Common chickweed (*Stellaria media*) (STEME)	Daisy (*Bellis perennis*) (BELPE)
Common nettle (*Urtica dioica*) (URTDI)	
Common ragwort (*Senecio jacobaea* now *Jacobaea vulgaris*) (SENVU)	

Creeping buttercup (*Ranunculus repens)* (RANRE)	
Dock species (*Rumex spp*) (RUMSS)- notably Broad-leaved dock (RUMOB) and Curled dock (RUMCR)	
Giant hogweed (*Heracleum mantegazzianum*) (HERMZ)	
Rushes (*Juncus spp*) (1IUNG)	
Thistle species (CIRSS) – notably Spear thistle (CIRVU) and Creeping thistle (CIRAR)	

Bracken (*Pteridium aquilinum*) (PTEAQ) is also a major weed in certain areas.

Long-Term Control

Claims for the long-term control of perennial species must be supported by effectiveness trials with assessments which examine any re-growth in the subsequent growing season. In the absence of such results claims may be acceptable for the control of 'top growth' or within season control only.

In addition, as grassland may be harvested for silage or hay following herbicide application applicants should address any effects of the cutting interval on the long-term control of perennial weed species. The cutting interval is the length of time required between application and silage cut to ensure the application is efficacious. Long cutting intervals of a month, for example, may be prohibitive to farmers using herbicides because it would mean that taking a silage cut might be delayed to such a point that the quality of the silage is reduced.

It should be noted that specific wording is required on the labels of herbicides authorised in grassland. Regulatory Update 05/2016 (http://www.hse.gov.uk/pesticides/news/information-update-0516.htm) provides text to be included on such products. Details are as follows;

In the 'SAFETY PRECAUTIONS' the following phrase must appear:

Livestock must be kept out of treated areas [for at least x days/weeks following treatment] IF RAGWORT IS PRESENT, FOLLOW THE GUIDANCE IN THE 'DIRECTIONS FOR USE'

The following phrase must appear in the 'DIRECTIONS FOR USE'

'Where ragwort is present users should consult the Code of Practice on How to Prevent the Spread of Ragwort. Ragwort plants sprayed with this herbicide are more palatable and contain higher levels of toxins. Animals should be excluded from treated areas

until any ragwort has completely recovered or died and there is no visible sign of the dead weed. Do not include treated ragwort in hay or silage crops.'

Principles of extrapolation for weeds

For major weeds a minimum of 10 acceptable trial results are required, with 3 results for minor species.

In many cases it will be possible to make a well-argued case for extrapolation from one crop to another if there is sufficient information on the weed control required, the competitiveness of the crop and the factors affecting acceptable weed control in both crops. All requests for extrapolation should be supported with an appropriate reasoned case.

Extrapolations may follow the guidance below:

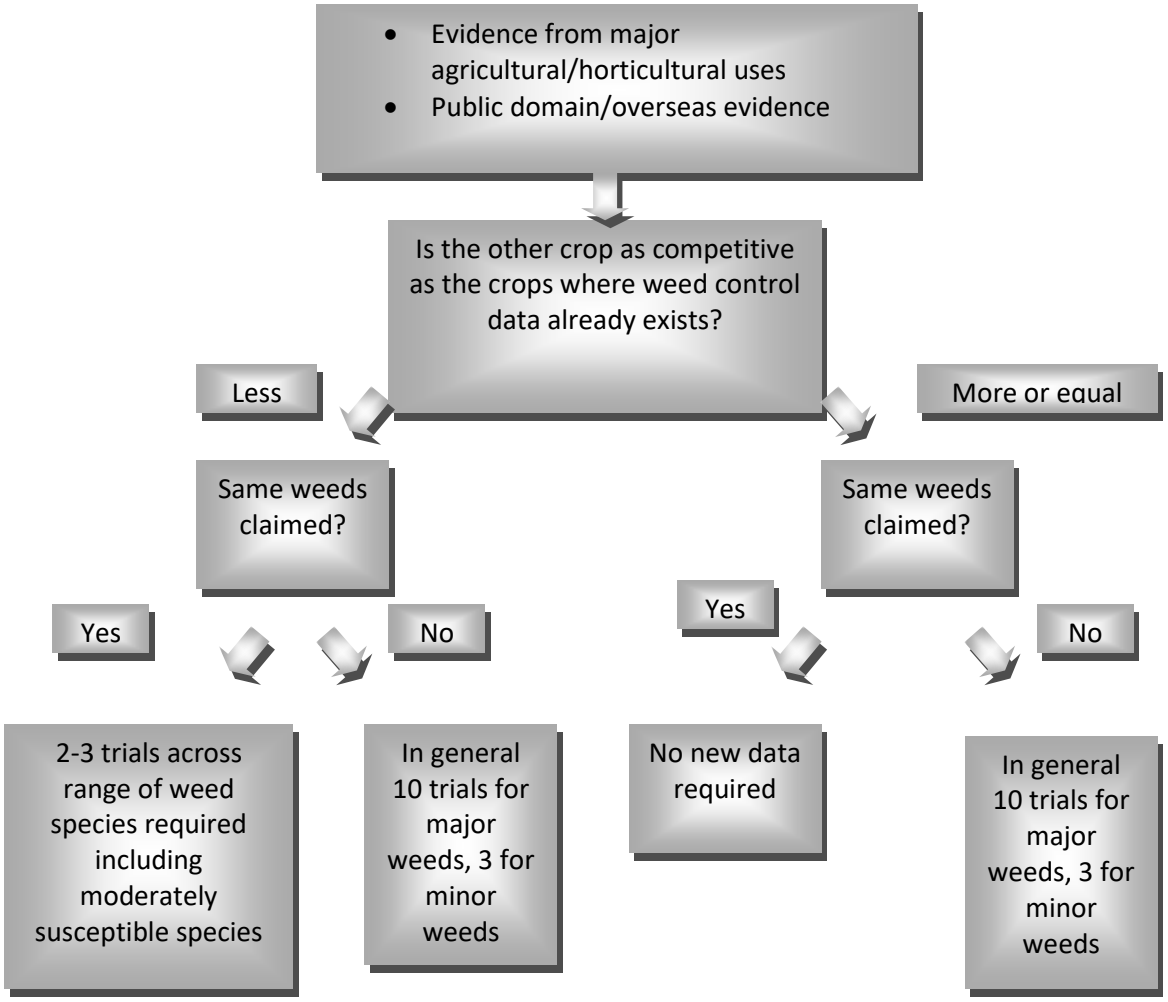
Table 3 – Extrapolation table

Situation	Crops	Notes
A- Arable – competitive crops	Cereals, grassland, oilseed rape	Extrapolation accepted within group and from B or C.
B- Arable/horticultural-poorly competitive crops	Sugar beet, peas, onions, linseed, brassicas	Extrapolation accepted within group and from C, but not A.
C- Other situations – non-competitive crops	Orchards, HONS, amenity vegetation, land not intended to bear vegetation	Extrapolation accepted within group, but not from A, and possibly B.

It may also be possible to extrapolate from established amenity grassland to agricultural grassland on the basis that amenity grassland tends to be kept much shorter than agricultural grassland and this provides less competition for weeds. Extrapolation from newly sown amenity grassland or cereals to newly sown grass may also be possible.

Finally, there is some scope to extrapolate from one weed species to a related species, for example from charlock to shepherd's purse and vice versa if one of the species is treated as a major weed and is supported by sufficient data i.e. at least 10 trials.

The flow chart below gives useful general guidance on extrapolation.


Evidence from major agricultural/horticultural uses
Public domain/overseas evidence
Is the other crop as competitive as the crops where weed control data already exists?
Less
More or equal
Same weeds claimed?
Same weeds claimed?
Yes
No
Yes
No
2-3 trials across range of weed species required including moderately susceptible species
In general 10 trials for major weeds, 3 for minor weeds
No new data required
In general 10 trials for major weeds, 3 for minor weeds

(IIIA 6.3) Resistance

Reference should be made to EPPO standard PP 1/213 *Resistance Risk Analysis* and to any current CRD guidance on resistance.

(IIIA 6.4) Adverse effects on treated crops

(IIIA 6.4.1) Phytotoxicity to target plants (including different cultivars), or to target plant products

The tests should provide sufficient evidence to permit an evaluation of the possible occurrence of phytotoxicity or other harmful effects after treatment with the plant protection product. Reference should be made to EPPO standard PP1/135 *Phytotoxicity assessment*

Relevant assessment parameters should be chosen on a case by case basis, depending on the product tested, mode of action, application time, etc. but may include;

Thinning: estimated cover

Delay in growth (to a stated growth stage)

Discolouration or necrosis: these assessments will generally concern the crop cover as a whole

Evidence should be largely provided by conducting field experiments under conditions as near as possible to commonly accepted practice and which reflect the proposed GAP. Where soil type, geographic location or planting date can affect safety to crops, products should be tested on a range of sites/situations.

Observations on phytotoxicity should be made in both effectiveness (at the proposed dose) and any specific crop safety trials (for herbicides at the proposed dose (N) and 2N doses). Phytotoxicity can depend on BBCH growth stage at application, climatic conditions and the varieties grown.

It is known that soil type can affect the crop safety of a product, and knowledge of the safety of the active from other uses and situations may be beneficial in developing appropriate label text.

(IIIA 6.4.2) Effects on the yield of treated plants or plant products

For insecticides and fungicides, in line with EPPO PP 1/135, yield data are not normally required. Data for insecticides and fungicides are needed only for new active substances where a case for crop safety cannot be made.

For herbicides, specific crop safety trials in the absence of weeds must include applications at N and 2N doses and trials should cover the range of proposed growth stages and treatment times for each use. The tests should provide sufficient evidence to permit an evaluation of the possible occurrence of yield reduction after treatment with the plant protection product.

Specific crop safety trials should be located across the Zone in areas representative of grass cultivation. EPPO standard 'PP 1/226 *Number of efficacy trials*' indicates that for authorisation in a single country/climatic zone, typically, at least 8 trials per major crop are required in an area of similar conditions, to cover the range of conditions of use, including soil types, weather conditions that are likely to be encountered.

Where there is a recommendation for use on newly sown grassland a minimum of 6 specific crop safety trials are required for herbicides, especially if there are no supporting data from effectiveness trials. This should include trials where applications are made where the grass is at the 2-3 leaf stage.

It is essential that symptoms of phytotoxicity are clearly linked to any subsequent yield effects.

The major agricultural grass species are: perennial rye-grass (LOLPE), Italian rye-grass (LOLMU), hybrid rye-grass (LOLBO), timothy (PHLPR) and cocksfoot (DACGL). Crop safety trials should be conducted in swards which include the major species and cultivars used in agricultural grassland. If the product is recommended as being safe to clover species, then trials must be conducted which support this claim.

In line with EPPO PP1/135 the following assessments are typically required;

- Fresh weight of yield in kg/ha taken from the centre of the plots
- Dry-matter content in samples from each plot

Dry matter yield should also be presented as a % of the untreated control. Since grass for silage may be harvested more than once from the same area, results should be presented separately for yields from a first cut to those from second or subsequent cuts.

Evidence of no unacceptable adverse effects on yield (quantity) is particularly important in instances where use of the product has caused phytotoxicity.

(III 6.4.3.) Effects on the quality of plants or plant product

Taint

This is not relevant to agricultural grassland.

Quality

In line with EPPO PP1/135 the following assessments are required;

- Protein content
- Quality indices (in vitro digestibility, metabolizable energy, etc.)

(IIIA 6.4.4) Effects on transformation processes

EPPO standard PP1/243 '*Effects of plant protection products on transformation processes'* indicates that an assessment of the effects of plant protection products on

crops for silage could be appropriate. If the applicant can demonstrate that residues are undetectable, or that any residues will not affect yeasts, a reasoned case may be sufficient to address these requirements. Data from preliminary screening tests for biological activity may provide valuable evidence of the absence of effects on yeasts or lactic bacteria.

(IIIA 6.4.5 Impact on treated plants or plant products to be used for propagation

Grass grown for seed is not in the scope of this guidance. An assessment is not required for grass to be grazed or cut for forage.

(IIIA 6.5.1) Impact on succeeding crops

Grassland may be established for a varying length of time from a single year to long-term or permanent pastures. Therefore, a consideration of any risks to succeeding crops is required.

A step-wise approach should be taken following EPPO standard 'PP 1/207 *Effects on succeeding crops*', starting with the herbicidal activity of the active substance, through glasshouse screening, laboratory bio-assays of treated field soils, field screening, monitoring of effectiveness/crop safety field trials and if necessary, specific following crop 'replanting' trials using risk mitigation measures such as different cultivation techniques. It is important to consider crops which are likely to be present in rotation with grass. For testing the biological activity of the test product, the product should be incorporated into the soil and the activity given as an EC (effective concentration). Endpoints from pre-emergence non-target plants tests presented in the Ecotoxicology Section of the dossier may be used to assess this risk to succeeding crops provided they are representative of the crops normally planted after grassland.

[Note There are some active substances used in grassland, e.g. aminopyralid, where residues can remain in grass from treated land and pass into the manure of grazing livestock where they remain tightly bound to the plant material until it decomposes. Similarly, the substance can also remain in grass fed as hay or silage to horses and housed cattle etc., again passing through the animals into the manure. If this manure is subsequently applied to soil or crops before the plant material in the manure has fully decomposed, susceptible crops may be damaged. Labels of products which contain aminopyralid therefore include warnings not to use manure from livestock, which have eaten grass from treated land, on susceptible crops, or on land intended for growing such crops, until all plant material had fully decomposed. Additional consideration may be required for such active substances].

(IIIA 6.5.2) Impact on other plants, including adjacent crops

A step-wise approach should be taken following EPPO standard 'PP 1/256 *Effects on adjacent crops*' and should be fully presented. It is important to consider crops which are likely to be present as adjacent crops to grassland (either already emerged or yet to emerge) in the UK. Endpoints from the pre and post-emergence non-target plants tests presented in the Ecotoxicology Section of the dossier may be used to assess the risk to adjacent crops provided they are representative of the crops normally found adjacent to potato crops. In addition to spray drift, other routes of exposure (e.g.

volatilization) should be considered for the formulated product as this may also affect sensitive adjacent crops.

(IIIA 6.5.1) Effects on beneficial and other non-target organisms

Visual observations in the field and relevant data produced for the Ecotoxicology section 9.5 may be used. However, if there are any specific positive claims of safety to beneficial organisms used in IPM systems, these must be supported. For specific guidance, discussions with CRD are recommended.

Other areas

Application equipment

Herbicide applications in grassland may be made through a range of different application machinery, depending on whether an overall spray is required or whether weeds will be spot treated or treated with a weed wiper. For each application method proposed on the product label, including a weed wiper, some evidence of weed control or a scientific reasoned case will be required at the proposed dose and timings.

Generally, where data are available through a conventional broadcast sprayer it is possible to extrapolate effectiveness and crop safety to a spot treatment or to application using a knapsack sprayer with the submission of a scientific reasoned case. Herbicides may also be applied in grassland using a weed wiper where, for example, a non-selective herbicide is being used or alternatively where clover may be present in the sward and the product to be applied is not 'clover-safe'. For products authorised as overall sprays in grassland, amending the authorisation to include use through a weed wiper may be supported for efficacy by conducting 4-5 bridging trials against key target weeds to demonstrate comparability between the different application methods.

References and Useful Information

Technical Note TN643 – SRUC – Weed management in grassland
British Grassland Society – Various publications
AHDB – Recommended grass and clover list
AHDB 2017 Grassland reseeding guide – (AHDB Grassland Re-seeding guide)
The Agricultural Notebook 20th Edition, R Soffe
Defra - Code of Practice on How to Prevent the Spread of Ragwort (Code of Practice on How to Prevent the Spread of Ragwort)
MAFF – Identification of Injurious Weeds (Injurious weeds)

Relevant EPPO standards

Target Specific

PP1/094 - Grassland renewal
PP1/146 - Retardation of growth in grass
PP1/193- Tipula larvae in grassland
PP1/061 - Weeds in grassland
PP1/217- Oscinella frit
PP1/046 – Wireworms

General Standards

PP 1/135 Phytotoxicity Assessment
PP 1/152 Design and analysis of efficacy evaluation trials
PP 1/181 Conduct and reporting of efficacy evaluation trials (including GEP)
PP 1/207 Effects on succeeding crops
PP 1/213 Resistance risk analysis
PP 1/223 Introduction to the efficacy evaluation of PPPs
PP 1/225 Minimum effective dose
PP 1/226 Number of efficacy trials
PP 1/241 Guidance on Comparable climates
PP 1/242 Taint tests
PP 1/256 Effects on adjacent crops
PP 1/278 Principles of zonal data production and evaluation

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk.

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

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