

EPPO STANDARD ON EFFICACY EVALUATION OF PLANT PROTECTION PRODUCTS

PP 1/331 (1) Principles of efficacy extrapolations for major uses

SPECIFIC SCOPE

This Standard describes the principles to be followed when considering effectiveness and crop safety extrapolations of plant protection products applied for major uses. The aim is to reduce the need for trial data on individual major crop and major pest situations, while maintaining appropriate data sets by describing the general principles that should be considered in making extrapolations. The Standard provides guidance for regulatory authorities and applicants in the context of the registration of plant protection products, and for the development of detailed lists of acceptable extrapolations. The Standard does not cover plant growth regulators (PGR) and plant defence inducers. Extrapolations of identical uses between different formulations of the same product are outside the scope of this Standard.¹

SPECIFIC APPROVAL AND AMENDMENT

First approved in 2024–09.

1 | INTRODUCTION

EPPO Standard PP 1/257 *Efficacy and crop safety extrapolations for minor uses* describes principles of extrapolation for minor uses and is used to support the development of a detailed list of acceptable minor uses extrapolations presented in the EPPO Database on PPP Extrapolation.² The principles described in the current Standard are closely aligned to PP 1/257 but are specifically aimed at major uses, where a key consideration is a need for a robust dataset for a major use in order to extrapolate to other major uses. The definition of a ‘robust’ dataset, and how to generate the data, is provided in EPPO Standards PP 1/214 *Principles*

of acceptable efficacy, with the number of trials for major uses described in PP 1/226 *Number of efficacy trials*. The use of data in a zonal context is described in EPPO Standard PP 1/278 *Principles of zonal data production and evaluation*.

The definition of ‘major uses’ varies between EPPO countries and there is no harmonized definition for the whole EPPO region. Key determinants include factors such as market values and area covered and distribution of the proposed crops, the pest impact and the scale of use of the applied plant protection products. Examples of extrapolations of major pests (with multiple host crops) in minor crops are presented in the minor use EPPO Extrapolation Database for a number of pests (including nematodes, slugs and spider mites) with multiple hosts. Extrapolations may be used either to allow an existing authorisation to be extended to include additional crops (or, in the case of herbicides, other non-crop uses) or pests in the absence of specific data, or to reduce the extent of the data package that would normally be required to support another use. Further information is available in EPPO Standard PP 1/226 *Number of Efficacy trials*.

Pests that are commonly regarded as major or more difficult to control, and therefore requiring specific data, are particularly relevant as key pests from which to extrapolate. There is potentially significant variability in pest, crop and product interactions, which can affect the validity of any extrapolation. For this reason, a precautionary approach should be taken for major uses, and extrapolations should not be made from less to more challenging control situations. The broader the range of conditions (whether pest or crop related) under which the product has demonstrated acceptable efficacy (and particularly how challenging the conditions were), the greater the scope for extrapolation without the need for additional data.

Extrapolations should be based on applying the plant protection product under comparable conditions of use, for example a comparable dose and timing. It may be possible however to have some flexibility in certain aspects, e.g. number and timing of applications or growth stages of the crop. However, this is dependent on differences not influencing effectiveness or crop safety and should be supported by robust argumentation.

¹Extrapolations of identical uses between different formulations of the same product may be possible but outside the scope of this Standard. PP 1/307 *Efficacy considerations and data generation when making changes to the chemical composition or formulation type of plant protection products* discusses criteria and data generation when comparing formulations.

²EPPO Database on PPP Data Extrapolation <https://extrapolation.eppo.int/>.

The following sections provide in detail the extrapolation principles for fungicides, insecticides or acaricides, and herbicides, with accompanying decision-making schemes (Appendix 1), and also some information on seed treatments. The list of factors in these schemes is not exhaustive, with mode of action, conditions of use, and extent of existing product knowledge determining whether an extrapolation is appropriate.

It is recognized that there will be other more specialized plant protection products and modes of action that are not specifically mentioned in this Standard, (e.g. bactericides, nematocides, molluscicides and some types of biopesticides), but the same considerations and principles will in general apply. Further information is also available in EPPO Standard PP 1/296 *Principles of efficacy evaluation for low-risk plant protection products* and EPPO Standard PP 1/276 *Principles of efficacy evaluation for microbial plant protection*. Plant growth regulators (PGR) and plant defence inducers are outside the scope of this Standard because there can be significant variations in physiological responses of crops to a PGR or a plant defence inducer and extrapolation is generally not possible.

This Standard does not specifically address extrapolations between protected and field situations, but the principles of comparability of the relevant pest and agronomic factors should be considered, along with the relative challenge in each situation when considering both effectiveness and crop safety extrapolations.

2 | EFFECTIVENESS

2.1 | General principles for extrapolation for effectiveness

Crops are considered to be:

- The *same* if they are identical (i.e. the same species) or very closely taxonomically related (i.e. the same genus such as for wheat TRZAX, durum wheat TRZDU and spelt TRZSP).
- *Similar* if they are taxonomically related (i.e. the same subfamily) and have a similar crop architecture, e.g. wheat, triticale, barley and rye. Depending on expert judgement, extrapolations may also be possible between crops of similar form e.g. different small fruit crops (3SMFC).

Pests are considered to be:

- The *same* if the same species or subspecies affects the crop to which extrapolation is proposed as that on which effectiveness has been proven and shows similar biology and epidemiology.
- *Similar* if the pest to be controlled shows similar biology and epidemiology and causes the same or lesser damage to the crop to which extrapolation is proposed.

Many pests have multiple host crops, whether as major or minor pests, allowing cross-supporting data packages and extrapolation possibilities. Pest biology is a critical factor.

The mode of action and extent of existing knowledge on the plant protection product and active substance is also important, and consideration should be given to the properties of the active substance (e.g. whether the active has systemic properties, works via contact or ingestion etc.). The season of sowing of a crop and timing of application of a plant protection product is also important.

Specific considerations for fungicides, insecticides or acaricides, and herbicides are presented in the following sections.

2.2 | Specific effectiveness extrapolations for fungicides

Where the same species (or subspecies) infects both the crop to which extrapolation is proposed and that on which effectiveness has been proven and shows similar biology and epidemiology, extrapolation is possible. For example, *Zymoseptoria tritici* (SEPTTR) on wheat and durum wheat, rye and triticale; *Puccinia striiformis* (PUCCST) on wheat and durum wheat, rye and triticale; *Stagonospora nodorum* (LEPTNO) on wheat and durum wheat, rye and triticale and *Rhynchosporium secalis* (RHYNSE) on barley, rye and triticale. Consideration may have to be given to the timing of infection and disease spread (e.g. in barley, powdery mildew develops at different times in winter and spring varieties).

Where the pathogen to be controlled has a similar biology and epidemiology (e.g. the different races of powdery mildew affecting different cereals) and causes the same or lesser damage to the crop to which extrapolation is proposed extrapolation is also possible, but relies on the similarity of many crop/pathogen factors.

Extrapolation is not possible if the pathogens to be controlled have a biology and epidemiology which is not similar.

The factors listed below are relevant when considering extrapolation of fungicide effectiveness data between different pathogens or different crops:

- *Crop*: Crop morphology, botanical family, cropping systems and growth pattern. It should be noted that closely related crop species may still differ significantly in growth pattern, or the plant parts that are to be harvested.
- *Pathogen*: Taxonomic relationship, biology, life cycle, plant parts infected and damage caused. Closely related pathogen species may exhibit significant differences, and a given pathogen species may infect crops in different ways. Different life stages of a pathogen may cause different types of damage.

- **Product:** Mode of action, timing, frequency and method of application, activity (preventative or curative treatment), systemic or non-systemic, formulation, dose and extent of publicly available data.
- **Agronomic factors:** Growing conditions (field or protected) and cultivation techniques, growing systems, soil type (particularly for soil treatments). Generally, controlled conditions are considered less challenging than field situations, particularly for foliar applications.

Appendix 1 (Figure A1) presents a scheme to be followed for major use extrapolations of fungicide effectiveness.

2.3 | Specific effectiveness extrapolations for insecticides or acaricides

Extrapolating from the same pest species within the same crop groups is the most appropriate approach but it may also be possible to extend extrapolation of the same species to other similar crop groups. However the latter will require that further consideration be given to crop agronomy and pest/crop interrelationships, for example if damage to the crop(s) is being caused by the same life stage (e.g. adult beetle feeding on foliage or larvae burrowing into plant stem).

Extrapolation to closely related pest species within a crop group can also be considered, but depends on the similarity of many crop/pest factors. This can include similar:

- pest behaviour,
- life stage at timing where control measures are required,
- feeding mechanisms
- types of damage that occur on the crops at similar timings and
- crop agronomy.

Extrapolation to pest species with different biology and/or behaviour, in the same crop, or other crop groups, is not recommended.

The factors listed below are relevant when considering the extrapolation of insecticides or acaricides use between different pests or different crops:

- **Crop:** Crop morphology, botanical family, cropping systems and growth pattern. It should be noted that closely related crop species may still differ significantly in growth pattern, leaf surface or harvested plant parts.
- **Pest:** Taxonomic relationship, biology, life cycle, behaviour, plant parts attacked and damage caused. Closely related pest species may differ significantly, and a given pest species may behave differently between crops. For example, the olive moth, *Prays oleae*

(PRAYOL), has three generations: the phyllophagous generation, developing on leaves, the anthophagous generation, developing on flowers, and the carpophagous generation developing on fruits. Similarities in feeding behaviour may make extrapolation across a range of pest groups appropriate, but the biology of individual pests is still important.

- **Product:** Mode of action, timing, frequency, method of application, activity (preventative or curative treatment), systemic or non-systemic, formulation, dose and extent of publicly available data.
- **Agronomic factors:** Growing conditions (field or protected) and cultivation techniques, growing systems, soil type (particularly for soil treatments).

Appendix 1 (Figure A2) presents a scheme to be followed for insecticides or acaricides major use effectiveness extrapolations.

2.4 | Specific effectiveness extrapolations for herbicides

Weeds may be major in one crop, and minor in another, depending on their relative competitiveness with the crop(s), time of emergence, germination and seasonal life cycle. Extrapolation from 'major' to 'minor' situations is acceptable, but not vice versa. It is also important to consider the likely weed spectrum within the crop where extrapolation is sought. If this differs significantly, further data may be required to support the extrapolation.

Extrapolation from one weed species to other weed species is generally not possible because of differences in sensitivity. However, if effectiveness of a plant protection product has been adequately demonstrated against a major weed species or a range of weed species from a particular plant genus, it may be possible in some cases to extrapolate.

When considering the acceptability of an extrapolation, account should be taken of timing of weed control, times of sowing/planting of the crop, competitiveness of the crop, time of harvesting. If other conditions described in this Standard that permit extrapolation apply, and if the new crop is as competitive as (or more competitive than) the crop(s) where weed control data already exists, extrapolation is possible. If the new crop is less competitive than the crop(s) where weed control data already exists, some confirmatory evidence may be required.

Extrapolation may be possible for the control of a particular weed species outdoors to the same species under protected conditions, since conditions are less variable and weed species under protection tend to be more sensitive. However, effectiveness under protected conditions cannot be extrapolated to outdoor use as

weeds grown outdoors are usually hardened off and therefore less sensitive to herbicides.

The effectiveness of soil-acting herbicides against weed species in the field cannot be extrapolated to use in potted plants. The effectiveness of herbicides (whether contact or soil-acting) cannot be extrapolated from use either outdoors or in potted plants to use in artificial substrate. This is due to the likelihood of different impacts on effectiveness arising from different growing media.

Appendix 1 (Figure A3) presents a scheme to be followed for herbicides major use effectiveness extrapolations.

3 | CROP SAFETY

3.1 | General principles for extrapolation of crop safety

Crop safety can vary considerably between crop species, and cultivars. The following points should be considered:

- Are there any crops where the product has an authorisation on a crop taxonomically related to the new crop?
- Is the architecture of the crops concerned similar?
- Are the agronomic growing conditions similar?
- Are there adequate crop safety data for the crop(s) from which extrapolation is required and across a range of cultivars?
- Are there any issues with phytotoxicity on other crops?
- Is the use (e.g. dose, water volume, timing) the same or sufficiently similar for the crops involved in the extrapolation?
- What is the mode of action of the active substance?
- What evidence of phytotoxicity is available from standard pre- and post-emergence pot tests and glasshouse varietal screens? Conditions in a greenhouse can affect the structure of plant surfaces, as well as biology, thereby changing the crop safety of a product. A case for extrapolation from the greenhouse to the field may be valid but caution is required. In some cases the protected crops may be more sensitive (perhaps because of a thinner layer of surface wax). In other cases the damage on outdoor crops may be influenced by factors not found under protection (e.g. sudden temperature changes, frost, abrasion by soil particles, wind, drought or water-logging).

Extrapolations may not be possible, for example, where the product has shown crop damage on some crops, where the crops concerned are significantly different, or where the crop is known to be particularly sensitive. In these cases, a full crop safety package is required.

3.2 | Specific crop safety extrapolations for fungicides and insecticides or acaricides

As a general principle, insecticides, acaricides and fungicides would be expected to have limited adverse effects on the crop. The extent of extrapolation between crops is largely depending on the use of the product, known sensitivity of the crop or the growth stage, and the depth of existing knowledge of the crop safety properties of the active or the product.

Evidence may be available from pot tests and greenhouse varietal screens from preliminary data for the active substance. This provides a baseline of inherent crop safety properties. Observations for phytotoxic effects should be made in the direct effectiveness trials and usually no separate selectivity trials are needed. However, if any adverse phytotoxic effects occur in some effectiveness trials at the authorized dose, then the effects of the double doses should be investigated and specific crop safety trials should be conducted (see PP 1/135 *Phytotoxicity assessment*). Using this combination of greenhouse and field data, information can be built up on a range of uses and perhaps formulation types, allowing scope for extrapolation to other crops in the absence of further crop safety data. Where the active or the product is known to cause significant symptoms or has existing label warnings, or the proposed extrapolation involves crops of known sensitivity, further limited data may be needed to support the extrapolation.

3.3 | Specific crop safety extrapolations for herbicides

For major uses, extrapolation between crops is not recommended, without crop safety data carried out in accordance with relevant specific EPPO PP1 Standards.

If a herbicide is demonstrated as only effective against monocotyledonous weed species, it may be possible to extrapolate crop safety between different dicotyledonous crops. However, this will depend on information available on the crop safety of the active substance.

If there is no crop exposure, crop safety data may be extrapolated between crops. This will depend on whether the herbicide is systemic, its route of uptake and the method of application. Shielded application, inter-row application (depending on timing), and spot application are examples of not exposing the crop to herbicides.

4 | SEED TREATMENT

Extrapolation between seed treatments of different crops is normally possible when seeding density and thousand-grain weight are similar and if a pest causes

similar damage. Different sizes of seeds between different crops may lead to different dilution effects, which may mean that extrapolation is not possible. Other factors of importance should be considered such as the sowing period, the time of appearance of pest, the application technique and the seed morphology. Crop safety aspects for extrapolation between seed treatments on different crops should consider the comparability of factors described above under the effectiveness sections. Considerations should be given to any known additional adverse impacts on aspects of crop safety such as crop emergence, delayed germination, or phytotoxicity to young seedlings.

APPENDIX 1 - DECISION-MAKING SCHEMES

When considering the suitability of the extrapolation, the first question concerns comparability of the conditions of use. These are defined for the product, and therefore data generated within similar or equal conditions of use are relevant. Further reference may also be made to the associated plant protection product label from which extrapolation is proposed because this will have more detailed instructions on proposed targets and use.

The figures below provide guidance on the various factors which should be considered, both for the crop and target. The list is not exhaustive, and equally which of these are of most importance in considering

the suitability of the extrapolation will depend on the individual pest and crop use. Generally, extrapolations of the same species to closely related or similar crops will be more appropriate, whereas extrapolating from one major species to a different major species is unlikely without further supporting data.

It is to be noted that the schemes presented here are simplified versions of recommendations made in this Standard. Please also refer to the guidance in the respective chapters above.

Explanation of terms used to express extrapolation possibilities:

- *Extrapolation not possible*: Extrapolation not possible without further data: extrapolation highly unlikely, but extrapolation could be considered when robust justification and additional data are provided.
- *Extrapolation may be possible*: Extrapolation may be possible with further evidence or relevant data: the possibility of extrapolation is dependent on the degree of differences in the pest and/or crop factors. If there are significant differences, then extrapolation is unlikely. Justification and/or confirmatory data to show similar performance of the plant protection product required for extrapolation.
- *Extrapolation possible*: extrapolation is possible with no additional evidence. These cases are generally suitable for inclusion in the EPPO Extrapolation Database.

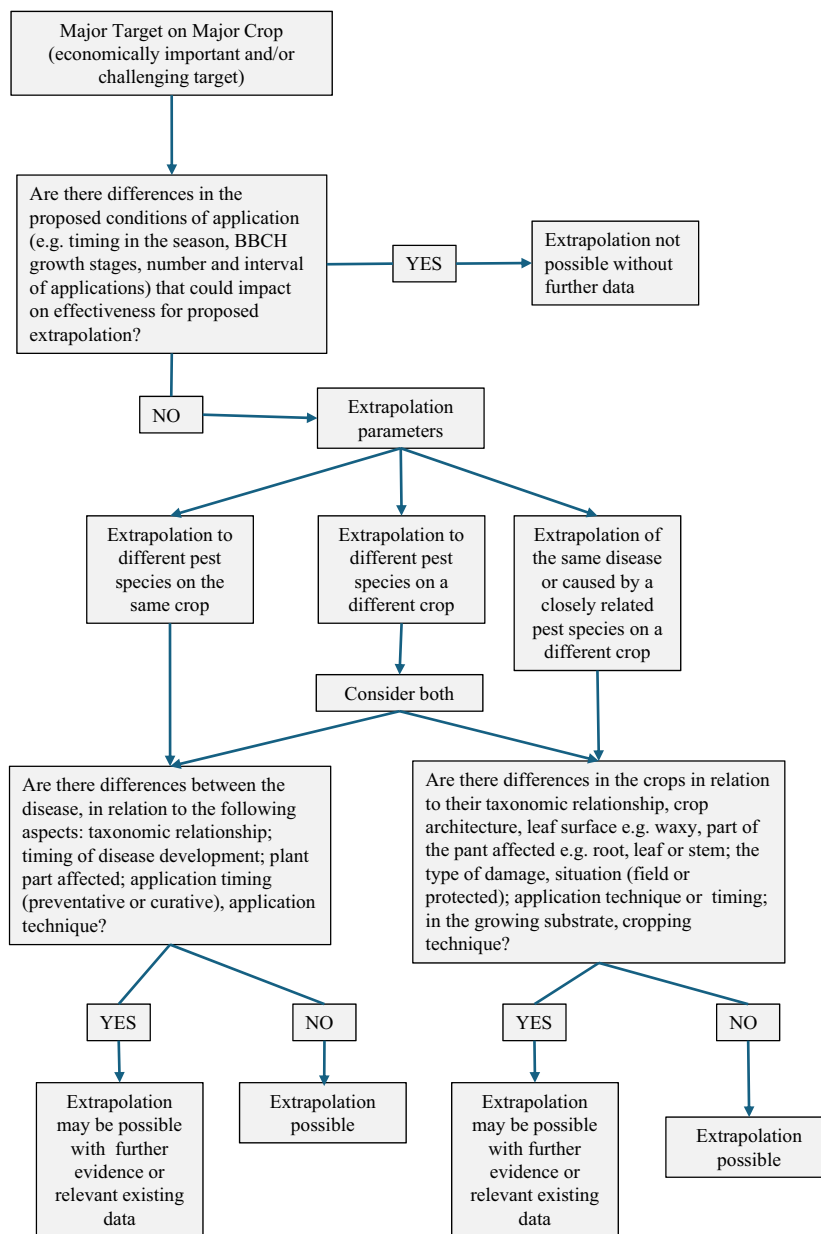


FIGURE A1 Scheme for fungicide effectiveness extrapolations for major uses.

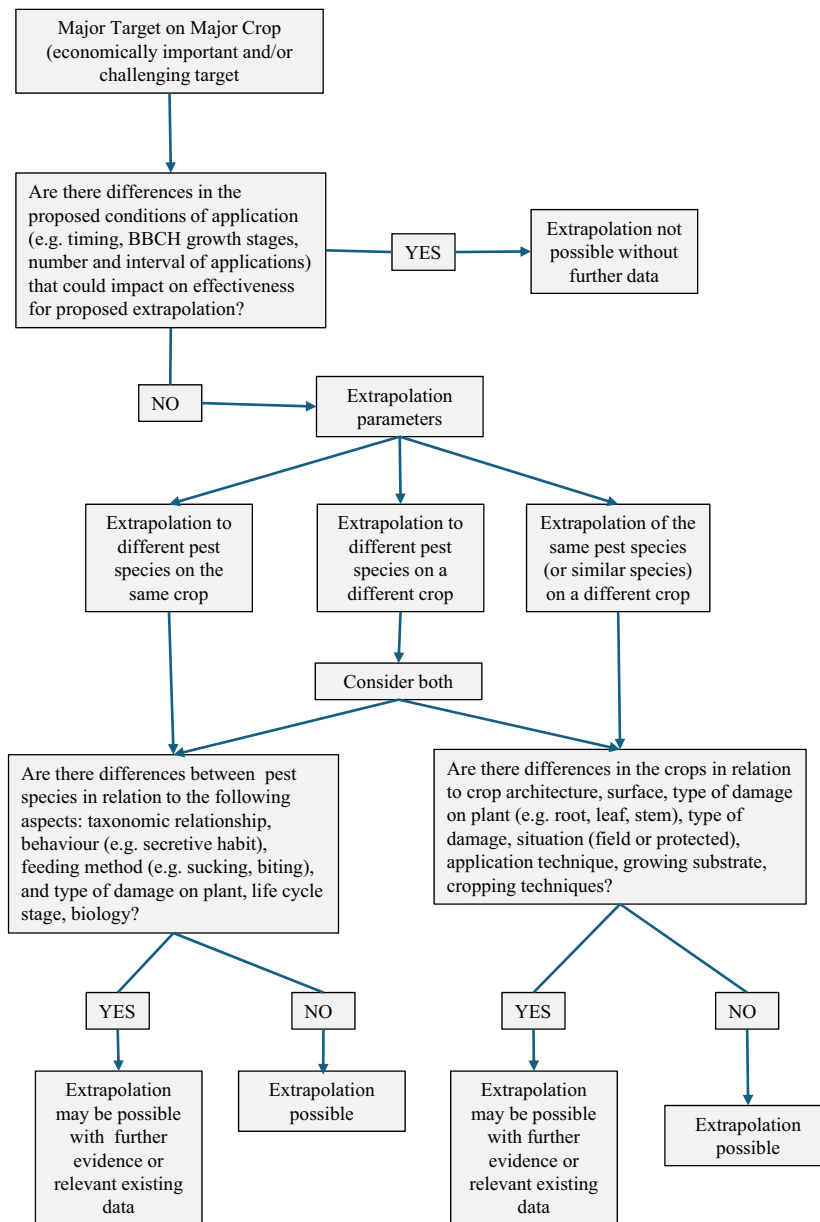


FIGURE A2 Scheme for insecticide or acaricide effectiveness extrapolation for major uses.

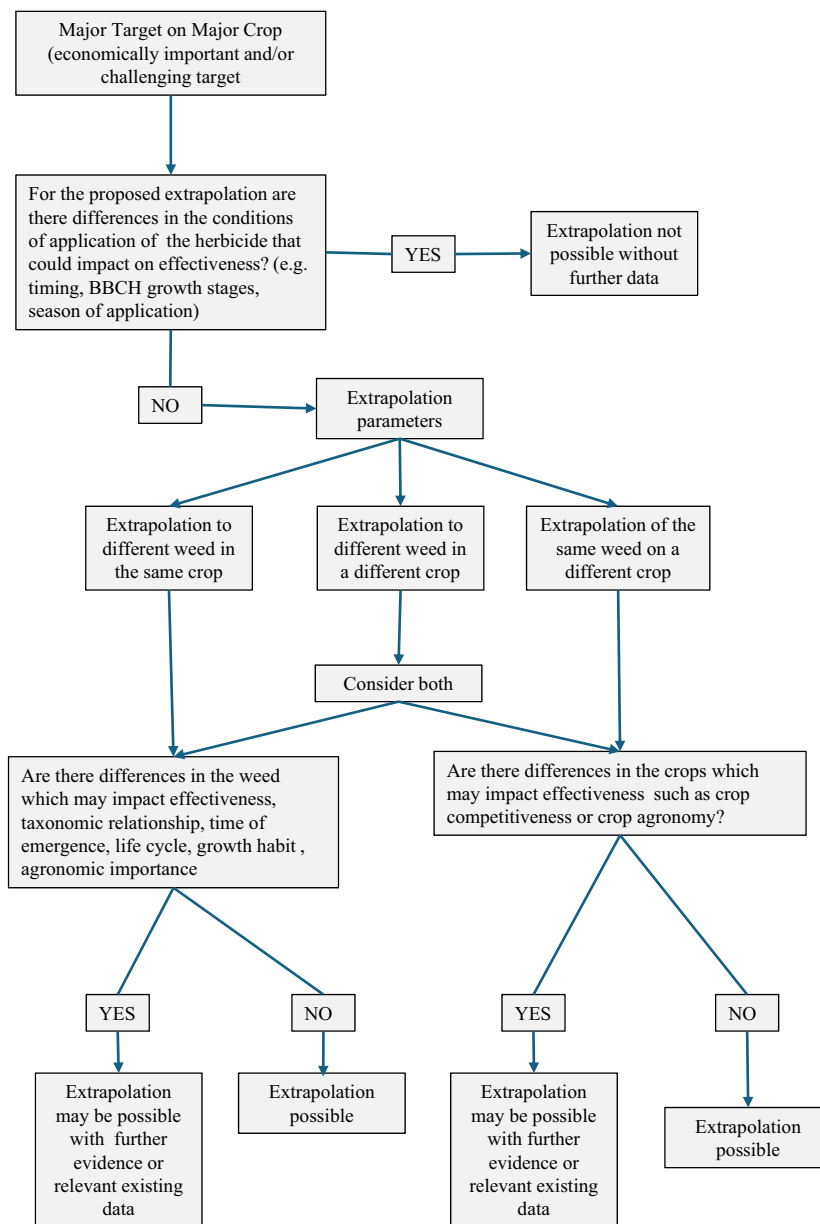


FIGURE A3 Scheme for herbicide effectiveness extrapolation for major uses.