European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Efficacy evaluation of plant protection products

Effects on adjacent crops

Specific scope

This standard describes methods used to examine whether the plant protection product causes negative effects on field crops grown adjacent to a field crop treated with that product.

Specific approval and amendment

First approved in 2007-09.

1. Introduction

This standard is intended as a general guideline on the methods that may be used to assess the risk of a plant protection product causing negative effects on field crops grown adjacent to a field crop treated with that product. The standard is not only intended to give information on the design of a particular trial, but as a stepwise guide to the assessments that can be carried out, incorporating available information from trials conducted for other purposes, such as non-target plant testing. Results generated with one formulation are normally applicable to other formulations of the active substance. However, when a plant protection product has been formulated specifically to reduce drift or volatilization of an active substance, e.g. slow-release granules, the specific product should be examined. This standard refers to spray drift only, not to vapour drift and run-off events.

The properties of a plant protection product can be investigated in preliminary laboratory or glasshouse trials. Its behaviour and biological activity in these trials, together with the predicted drift during the application and the distance to any sensitive adjacent crop, will determine whether field trials are required and if so, their extent and type. Data generated for environmental risk assessments and efficacy studies can also be used to avoid additional testing. For many plant protection products, further testing will not be required.

Where effects are predicted from preliminary laboratory or glasshouse trials, observational trials on small plots can be carried out to examine whether drift of the plant protection product onto adjacent crops can cause phytotoxic effects under field conditions.

If effects are observed on sensitive crops in field trials, a risk management strategy will be required to minimize risks. This may include label restrictions requiring the use of anti-drift nozzles or specified distances between the treated crop and adjacent crops. Appendix 2 presents an appropriate decision-support scheme (derived from the EPPO Standard PP 3/13 *Environmental risk assessment scheme for plant protection products*: Chapter 12: Non-target terrestrial higher plants).

2. Decision-support scheme for the risk assessment for adjacent crops

The scheme follows a sequential or tiered approach. Toxicity values are compared with predicted environmental concentrations to develop a Toxicity:Exposure-Ratio (TER is calculated as the ED_{50}-value divided by the estimated drift value; see Appendix 2). The TER is then compared with a trigger value that is based on expert judgement or derived empirically. Progression to the next tier is warranted if the safety margin is not met, while testing is stopped if the safety margin is met or exceeded.

Tier 0: If no adverse exposure of adjacent crops will occur under field conditions (e.g. seed treatment, use of granules, application by watering can) no further testing is necessary.

Tier 1: If a relevant exposure is likely, the phytotoxic properties of the plant protection product should be assessed using single-dose phytotoxicity screening data for crop plants at the maximum application rate on a range of species representative of plant families for which significant negative activity has been found, based on preliminary glasshouse tests, knowledge of the mode of action of the product, and the potential presence of that crop in a field adjacent to the treated crop. These data can usually be taken from the non-target plant testing, as this testing nearly always includes crop plants, as well as from other greenhouse or laboratory tests, or from efficacy studies for fungicides and insecticides if a range of sensitive crops have been tested. Appendix 1 gives guidance on how to conduct such plant tests. If the plant protection product causes no phytotoxic symptoms on the plant species tested, no further testing is necessary.

Tier 2: If phytotoxicity is observed, dose-response relationships for species representing plant families for which significant negative activity has been found should be generated to quantify the level of effect using both soil and foliar exposure scenarios. If there is a clear indication that the activity via one route of exposure (soil or leaves) is by far stronger than by the other, tests should be limited to that exposure route. These data can also be taken from the non-target plant

(ecotoxicology) section as well as from other greenhouse or laboratory tests. See Appendix 1 for the plant testing.

Predictions of spray drift can be taken from the standard models. The dose of the plant protection product that can be expected to drift at distances of e.g. up to 5 m (depending on the national risk assessment scenarios) from the treated area should be calculated. The TER-value is calculated by comparing the biological activity (ED_{50}-value for each plant species) to the estimated drift values in order to predict the likelihood of effects on adjacent crops at different distances from the treated crop.

If the TER-value of the most sensitive crop is greater than 1 (or the specific national level, if higher), no further testing is necessary. If it is likely that damage will occur when a sensitive adjacent crop is planted, then a refined calculation or field testing will be necessary to examine the extent of effects.

Tier 2a: In countries where the use of low-drift nozzles or other anti-drift measures and/or buffer zones are common agricultural practice a refined risk assessment can be done. The calculation of the drift value is repeated considering any low-drift application techniques and/or distances from the treated field. If the TER-value of the most sensitive crop is greater than 1 (or the specific national level, if higher), no further testing is necessary. On the label of the plant protection product, appropriate risk mitigation measures should be added according to the national requirements.

Tier 3: If a refined risk assessment is not possible or if phytotoxic effects are still likely, then a series of semi-field or field tests is necessary as described below. The first step would be to undertake field screening (which may be unreplicated) pre-emergence and/or post emergence over a sufficient test period, using the crop species known to be the most sensitive following testing at *Tiers 1, 2 and 2a*. The doses applied should be representative of the potential drift up to e.g. 5 m (depending on the national risk assessment scenarios) and crop growth stages likely to be present at the proposed time of application of the plant protection product, assessing phytotoxic effects (observed as visible plant damage or shoot weight reduction). Any crop species found to be sensitive (showing phytotoxic effects) following this testing would need to undergo further field testing.

In the following step ‘small-plot’ field tests should be done using the most sensitive representative adjacent crop, again employing doses representative of the potential drift up to e.g. 5 m (depending on the national risk assessment scenarios) and crop growth stages likely to be present at the proposed time of application of the plant protection product, assessing both phytotoxic effects (observed as visible plant damage or shoot weight reduction) and effects on biomass. If the phytotoxic effects do not result in significant effects on biomass reductions, no further testing is necessary. However, if phytotoxic symptoms lead to biomass reductions, appropriate restrictions should be added to the label according to the national requirements.

3. Field trials

As a range of different crops could be grown as adjacent crops, all the trial parameters should be consistent with the specific standard for the named crop.

3.1 Experimental conditions

3.1.1 Selection of crop and cultivar

The trial should be performed on crops that are normally grown adjacent to the crop(s) specified for the intended use. According to the proposed use and time of application of the plant protection product, the crops may already have been planted (post-emergence), or in the process of germination (pre-emergence). For each crop, the selected varieties should include the most common varieties.

3.1.2 Trial conditions

The trial should be set up in the field. Cultural conditions (e.g. soil type, fertilization, tillage) should be uniform for all plots of the trial and should conform with local agricultural/horticultural practice. The preceding crop should be recorded as well as any plant protection products used on or after it. Sites treated with plant protection products known to have phytotoxic effects on the test crop should be avoided.

The trial should form part of a series carried out in different regions with distinct environmental conditions and preferably in different growing seasons (see EPPO Standard PP 1/181 *Conduct and reporting of efficacy evaluation trials, including good experimental practice*).

3.1.3 Design and lay-out of the trial

Treatments: test product(s) and untreated control, arranged in a suitable statistical design. Plots and replicates should be as specified in the specific EPPO Standard PP 1 *Efficacy evaluation of plant protection products*.

For further information on trial design, see EPPO Standard PP 1/152 *Design and analysis of efficacy evaluation trials*.

3.2 Application of treatments

3.2.1 Test product(s)

The product(s) under investigation should be the named formulated product(s) and should be applied as specified for the intended use (e.g. with an adjuvant); see EPPO Standard PP 1/181 *Conduct and reporting of efficacy evaluation trials, including good experimental practice*.

3.2.2 Mode of application

Applications should comply with good standard practice.

3.2.2.1 Type of application

The type of application should be as specified for the intended use.

3.2.2.2 Type of equipment

Application(s) should be made with suitable equipment providing an even distribution of product on the whole plot or accurate directional application where appropriate. Factors such as volume rate, operating pressure, nozzle type, should be chosen in relation to the intended use.

3.2.2.3 Time and frequency of application

The same product may be applied once or in successive applications. The number of applications and the date of each application should be as specified for the intended use to investigate the possibility of cumulative effects in case of successive applications. The state (emergence, growth stage) of the crop and the number and date of each application should be recorded. If crop types or cultivars can be treated at a range of timings in the year, then application to the adjacent crop(s) should be done over a range of representative timings.

3.2.2.4 Doses and volumes

The product should be applied at the dosages likely to reach the crop up to e.g. 5 m (depending on the national risk mitigation scenarios) away from the plot treated with the intended maximum dose. Based on this dose, experimental doses are calculated by selecting the percentage of drift at the relevant distance.

The dosage applied should normally be expressed in kg (or L) of formulated product per ha and volume of water (L ha^{-1}) should also be recorded for sprays. It may also be useful to record the dose in g of active substance per ha or concentration (%).

3.2.2.5 Data on other plant protection products

If other plant protection products (or any biocontrol agents) have to be used, they should be applied uniformly to all plots, separately from the test product. Possible interference with these should be avoided.

3.3 Mode of assessment, recording and measurements

3.3.1 Meteorological and edaphic data

3.3.1.1 Meteorological data

Around the date of application (e.g. 7 days before and 7 days after the application), meteorological data should be recorded which are likely to affect the development of the crop and/or the performance of the active substance. This normally includes at least precipitation and temperature. All data should preferably be recorded on the trial site, but may be obtained from a nearby meteorological station. Its location and distance from the trial site should be noted.

On the date of application, meteorological data should be recorded which are likely to affect the quality and persistence of the treatment and they should preferably be recorded on the trial site. This normally includes at least precipitation (amount in mm and the time between treatment and start of precipitation), temperature (average, maximum and minimum in °C), wind speed and direction (at trial site during application), and relative humidity. Record whether leaves are wet at the time of treatment. Any significant change in weather should be noted.

Throughout the trial period, extreme weather conditions such as severe or prolonged drought, heavy rain, late frosts, hail, etc., which are likely to influence the results, should also be reported. All data concerning irrigation should be recorded, as appropriate.

3.3.1.2 Edaphic data

The following characteristics of the soil should be recorded: pH, organic matter content, soil type (according to a specified national or international standard), moisture (e.g. dry, wet, waterlogged), seed-bed quality (tilth, if appropriate) and fertilizer regime.

3.3.2 Type, time and frequency of assessment

The state of the crop at application and assessment should be recorded. It usually includes the BBCH growth stage and general condition of a crop.

3.3.2.1 Type

The test crops should be examined for the presence of phytotoxic effects. In addition, any positive effects should be noted. The type and extent of such effects should be recorded and, if there are no effects, this fact should also be recorded.

Phytotoxicity should be scored as follows:

(1) if the effect can be counted or measured, it should be expressed in absolute figures

(2) in other cases, the frequency and degree of damage should be estimated. This may be done in either of two ways: each plot is scored for phytotoxicity by reference to a scale, or each treated plot is compared with an untreated plot and % phytotoxicity estimated.

In all cases, unintended effects to the crop should be accurately described (stunting, chlorosis, deformation, delay in emergence, etc.). For further details, see EPPO Standard PP 1/135 *Phytotoxicity assessment*, which

contains sections on individual crops and specific EPPO Standards in series PP 1.

The assessment relates to damage due to both the test product and to other influences. The latter are determined in the untreated plot. It is important to consider the possible interaction between phytotoxicity and stress factors (damage due to cultural operations, lodging, attacks of pests, prolonged heat or cold, etc.).

3.3.2.2 Time and frequency

As a guide, the following observation times may be chosen. In the case of successive applications it is necessary to make an assessment before each application. An assessment before the first application is only needed if the biomass of the crops shows clear visual differences between individual plots.

For pre-emergence application

1st assessment: during emergence (in order to be able to assess any delay in emergence or thinning, preferably determined by counting the plants).

2nd assessment: at the end of emergence.

3rd assessment: at the 2 to 3 leaf stage.

For post-emergence application

1st assessment: at application of the test product to make sure that the crop shows no abnormal symptoms before beginning the trial.

2nd assessment: 1 to 2 weeks after application. Numbers of crop plants present should be estimated.

3rd assessment: 3 to 4 weeks after application.

Further phytotoxicity assessments should be made during the life of the crop.

3.4 Quantitative and qualitative recording of yield

Where trials are harvested the method of recording yield or components of yield should be appropriate to the test crop. This is described for some crops in EPPO Standard PP 1/135 *Phytotoxicity assessment*. See specific EPPO Standards in series PP 1 if the test product is a herbicide or a growth regulator.

3.5 Results

The results should be reported in a systematic form and the report should include an analysis and evaluation. Original (raw) data should be available. Statistical analysis should normally be used by appropriate methods which should be indicated. If statistical analysis is not used, this should be justified. See also EPPO Standard PP 1/152 *Design and analysis of efficacy evaluation trials*.

References

OECD (2006a) Guidelines for Testing of Chemicals. Section 2: Effects on Biotic Systems. Test No. 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. OECD, Paris (FR).

OECD (2006b) Guidelines for Testing of Chemicals. Section 2: Effects on Biotic Systems. Test No. 227: Terrestrial Plant Test: Vegetative Vigour Test. OECD, Paris (FR).

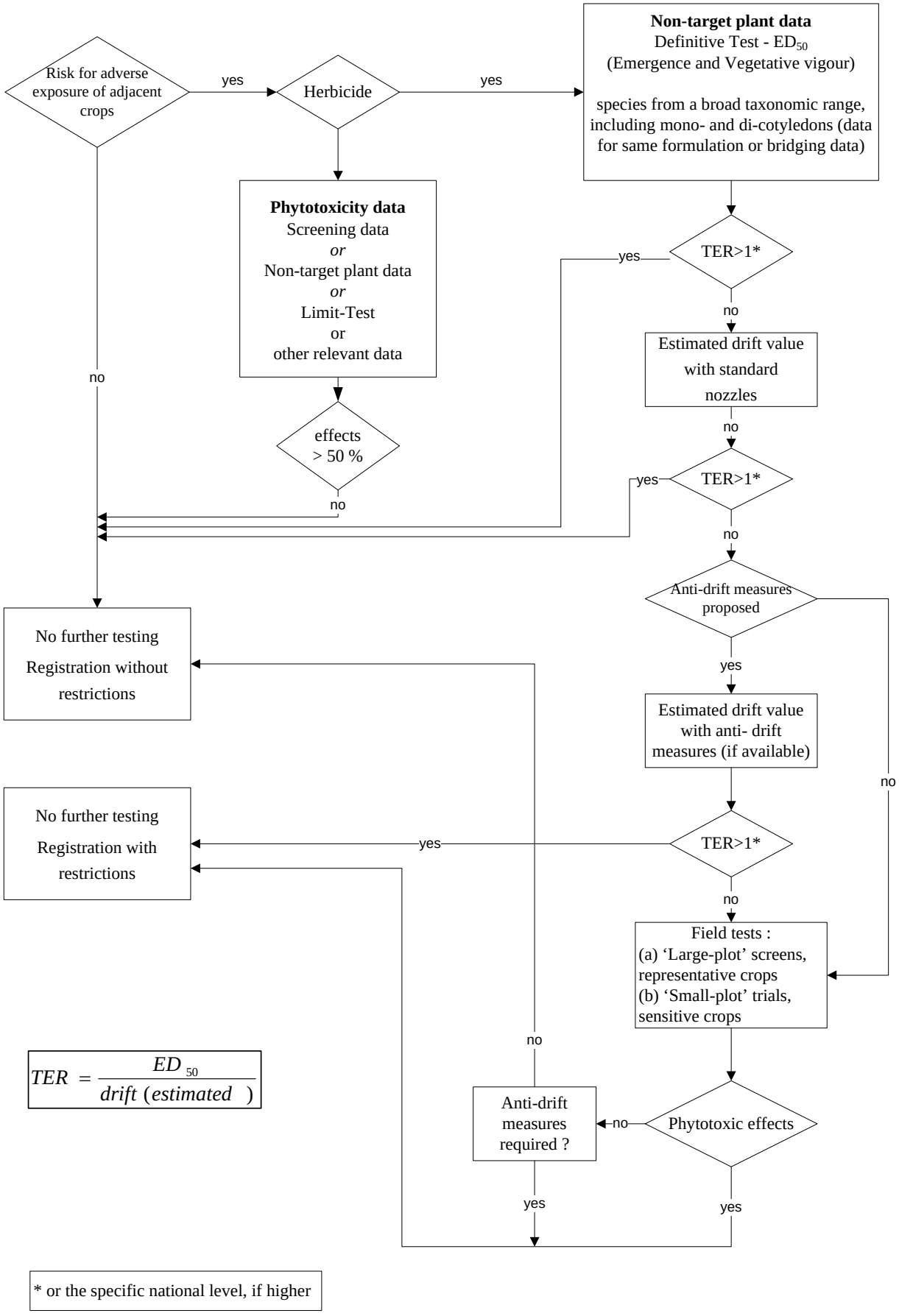
Appendix 1 Method for screening the sensitivity of crop species to active substances

Test plants are sown in pots. Test species are chosen to be representative of the range of crops which are present at the time of application of the plant protection product (proposed use) and may also be adjacent crops. The bioassay should also include species already demonstrated to be very sensitive to the active substance. Test plants should be sown so that sufficient numbers of plants emerge for the purpose of the test. For testing post-emergence activity the plants can be transplanted. The test should be replicated and randomized, and plants should be grown in controlled conditions so that growing conditions are the same for all plants. An assessment should be made of emergence (for pre-emergence testing only) and all aspects of growth of the test plants in the treated pots compared with untreated plants.

Plant weight should be measured after an interval sufficiently long for effects of the active substance to be seen; this depends on the mode of action of the active substance.

For further information, see also: OECD (2006a, b).

Appendix 2 Decision-support scheme for the risk assessment for adjacent crops



$$TER = \frac{ED_{50}}{drift\ (estimated\ )}$$

* or the specific national level, if higher