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EPPO STANDARD

EPPO Standard on Efficacy Evaluation of Plant Protection Products

PP 1/343 (1) Principles for conducting efficacy trials for plant protection product adjuvants to define their field of use

Specific scope: This Standard provides guidelines on how to generate efficacy data to support claims for adjuvants (used with plant protection products) for countries which have national requirements for the authorization of adjuvants.

This Standard provides recommendations on how to perform efficacy trials with adjuvants and plant protection products to determine the field of use of the adjuvant and how to extrapolate the data to other plant protection products or other fields of use. This Standard should be read in conjunction with EPPO Standard PP 1/291 *Evaluation of the influence of tank mix adjuvants on the efficacy of plant protection products*.

Particular attention should be paid to additional specific national requirements where they exist. Therefore, applicants are advised to liaise with competent authorities before conducting trials.

Specific approval and amendment: First approved in 2026–09.

1 | INTRODUCTION

The purpose of this Standard is to specify the efficacy requirements regarding the authorization of adjuvants. The Standard provides recommendations for countries where the use of an adjuvant in combination with a plant protection product (PPP) requires authorization of that adjuvant in a similar manner to a PPP. This Standard is only applicable to voluntary tank mixtures, where the use of an adjuvant is recommended. For mandatory tank mixes, where a PPP must be used with an adjuvant, the adjuvant is an integral part of the core dossier of the PPP (as defined in specific EPPO Standards). This Standard provides information on the representative crops, targets, and classes of active substances that can be tested in effectiveness and crop safety trials, to support authorization of the adjuvant.

For the purpose of this Standard, 'field of use' refers to a defined group of crop–target–product combinations in which an adjuvant is intended to be used with PPPs and for which efficacy is considered sufficiently similar to allow extrapolation of trial results. A field of use may therefore encompass several crops, targets or PPPs that share comparable biological, agronomic or application characteristics.

This Standard is designed to be used in conjunction with the EPPO Standards in the series PP 1 on efficacy evaluation of PPPs. Depending on the function of the adjuvant (as defined in EPPO Standard PP 1/291) different representative tests are suggested. This Standard also considers the principles for possible extrapolations to different crops and targets that can be used for a more generic authorization of a specific adjuvant. For field trial methodology, reference should be made to EPPO Standard PP 1/291.

2 | ADJUVANTS IN VOLUNTARY MIXTURES: GENERAL PRINCIPLES

For adjuvants in voluntary mixtures, the following apply:

2.1 | Fields of use

- Trials should be conducted on representative crops where the effectiveness and selectivity of the adjuvant can be sufficiently demonstrated.
- Extrapolations may be possible between all crops that have the same field of use (Tables 1 and 2).

2.2 | Number of trials and other supportive data

A dataset should be generated for each claimed field of use. The number of trials should be decided on a case-by-case basis according to the specific field of use and the degree of extrapolation required. If multiple fields of use are claimed, the number of trials may be reduced, provided there is adequate justification and

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an appropriate dataset. It is advisable to generate data across two growing seasons.

In addition to the full dose of the PPP (N), a lower dose (e.g. 0.8 N) should also be tested in combination with the adjuvant (see EPPO Standard PP 1/291). The latter is important as the PPP on its own at its authorized rate could display maximum efficacy and therefore mask the possible benefit of the adjuvant. To obtain an authorization for a particular adjuvant, it is necessary to demonstrate the benefit of the adjuvant by comparing the efficacy of the applied PPP with and without the adjuvant. At a lower dose, the PPP may face a more challenging situation, in which the adjuvant could improve efficacy.

2.3 | Possibilities for extrapolation

Extrapolation possibilities will reflect different fields of use and will be discussed separately for applications of the adjuvant in tank mixes with insecticides/acaricides, fungicides, herbicides or plant growth regulators. In the following Sections, the different fields of use will be presented according to adjuvant functions (see EPPO Standard PP 1/291) or the active substance function.

3 | ADJUVANTS IN ASSOCIATION WITH INSECTICIDES AND ACARICIDES

Crop safety assessments should be conducted directly in the effectiveness trials. If there is an increase in phytotoxicity when combining an insecticide or acaricide at N dose with an adjuvant at the intended dose (n), specific crop safety trials on the crops of concern should be carried out. If unacceptable phytotoxicity symptoms appear on one of the crops tested, the risk assessment should be refined by testing other crops.

3.1 | Improving the retention or spread on the target surface

Three fields of use for insecticides and one for acaricides (as described in Table 1 below), can be defined. If the benefit of using an adjuvant can be demonstrated on *one* representative use, the results could be extrapolated to *all* uses belonging to the same field of use. Also, extrapolation to less challenging crop-pest combinations can be considered. If a benefit is demonstrated in all three fields, the results can be extrapolated to all crop-insecticide combinations. However, particular attention should be paid to additional specific national requirements where they exist. Moreover, if a benefit against mites can be demonstrated, the authorization can be extended to all crop-acaricide combinations as well.

The PPP used in the trials should be selected with care, according to the representative uses tested to allow the results from one insecticide to be extrapolated to all insecticides.

3.2 | Preserving/maintaining spray mix properties

If an applicant makes a claim for 'preservation' or 'maintenance of the properties of the preparation', specific effectiveness trials are only useful if that is the only function claimed. In such cases, trials should be conducted with one or more active substance(s) making it possible to highlight the improvement in preservation of the spray mix properties (e.g. sensitivity to UV, temperature, pH etc.) on one or more representative crop and target combination(s) such as:

- Aphids on brassicas (*Brevicoryne brassicae* BRVCBR, *Myzus persicae* MYZUPE)
- Caterpillars on brassicas (*Pieris brassicae* PIERBR, *Mamestra brassicae* BARABR)
- Fruit-tree red spider mite on pome fruits (*Panonychus ulmi* METTUL)

TABLE 1 Fields of use for insecticides and acaricides when investigating retention or spread on the target surface.

Field of use	Proposed representative uses
Any insect on crops with high-density foliage (e.g. potato, orchard crops, beet)	Codling moth *Cydia pomonella* (CARPPO) on orchard crops and/or Colorado beetle *Leptinotarsa decemlineata* (LPTNDE) on potato
Any insect on crops with waxy leaves (e.g. brassicas)	Caterpillars (*Pieris brassicae* PIERBR, *Mamestra brassicae* BARABR) on brassicas and/or Aphids (*Brevicoryne brassicae* BRVCBR, *Myzus persicae* MYZUPE) on brassicas
Any insect on crops with tight foliage, upright growth, difficult to reach plant parts - hidden insects (e.g. leek, onions, leafy vegetables)	Lettuce aphid (*Hyperomyzus lactucae* HYPELA) on lettuce and/or caterpillars (*Pieris brassicae* PIERBR, *Mamestra brassicae* BARABR, *Lobesia botrana* POLYBO, *Eupoecilia ambiguella* CLYSAM, *Argyrotaenia ljungiana* ARGTPU) on leafy vegetables and/or grapevines and/or thrips (*Thrips tabaci* THRITB) on leek and/or onions and/or grain aphids (*Sitobion avenae* MACSAV, *Metopolophium dirhodum* METODR) on cereals
Any mites, any crops	Fruit-tree red spider mite (*Panonychus ulmi*, METTUL)

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If a benefit can be demonstrated for *one* specific representative use, the results could be extrapolated to *all* insecticides and acaricides regarding the use claimed.

3.3 | Improving 'wash-off' resistance

If an applicant makes claims for 'improvement of wash-off resistance (rainfastness)', specific efficacy trials are only useful if this function is the only one claimed. In such cases, trials should be conducted with one or more active substance(s) making it possible to highlight the improved wash-off resistance on one or more representative crop and pest target combination(s) such as described in point 3.1, and trials can be conducted under protected conditions. However, if the 'improvement of wash-off resistance' function is claimed in combination with other functions, its evaluation may be covered within combined trials that also assess other claimed properties of the product.

3.4 | Improving the speed or rate of penetration

The function 'improvement of the speed or rate of penetration' is particularly relevant for systemic or translaminar (mostly lipophilic) substances. If penetration enhancement is the only claimed function, efficacy trials should be conducted with a systemic or translaminar active substance on relevant targets that are sensitive to the degree of penetration of the insecticide or acaricide into the plant, such as:

- Tomato leaf miner (*Phthorimaea absoluta* GNORAB or *Keiferia lycopersicella* GNORLY)
- Rosy apple aphid (*Dysaphis plantaginea* DYSAPL)
- Beet leaf miner (*Pegomya hyoscyami* PEGOHY)
- Onion/leek leaf miner (*Liriomyza cepae* PHYBCE)
- Onion/leek thrips (*Thrips tabaci* THRITB)
- Aphids on brassicas

If the benefit of using an adjuvant can be demonstrated for one specific representative use, the results can be extrapolated to all insecticides and acaricides regarding the specific function claimed. If multiple claims are made for a specific adjuvant (e.g. improvement of the penetration and retention or spread), efficacy trials should be performed in accordance with the representative uses as proposed for 3.1 *Improving the retention or the spread on the target surface*'. In such cases it can be useful to simultaneously test the penetration enhancement by using a systemic or translaminar active substance in those trials.

3.5 | Improving the quality of the spray mix

When this function is claimed, it may be useful to confirm that the adjuvant has no negative impact on the effectiveness of the insecticide or acaricide by conducting efficacy trials.

4 | ADJUVANTS IN ASSOCIATION WITH FUNGICIDES

A crop safety assessment should be made directly in effectiveness trials. If there is an increase in phytotoxicity when combining a fungicide at the N dose with the adjuvant at the intended dose (n), specific crop safety trials on the relevant crop(s) should be conducted. If unacceptable symptoms of phytotoxicity occur on one of the crops tested, the risk assessment should be refined by testing additional crops.

4.1 | Improving the retention or the spread on the target surface

Five fields of use can be defined - see Table 2 below. If the benefit to using an adjuvant can be demonstrated

TABLE 2 Fields of use for fungicides when investigating retention or spread on the target surface.

Field of use	Proposed representative uses
Any fungal foliage disease on crops with high-density foliage (e.g. potato, orchard crops, beet)	Late blight (*Phytophthora infestans* PHYTIN) on potato and/or Scab (*Venturia inaequalis* VENTIN) on orchard crops and/or Powdery mildew (*Erysiphe betae* ERYSBE) on beet and/or Mildews (*Plasmopara viticola* PLASVI, *Erysiphe necator* UNCINE) on grapevine
Any fungal disease on crops with waxy leaves (e.g. brassicas)	Any fungal disease on leafy cabbage and/or oilseed rape and/or leaf blight (*Didymella pinodes* MYCOPI) on pea
Any fungal disease on crops with tight foliage, upright growth, difficult to reach plant parts (e.g. leek, onions, leafy vegetables)	Downy mildew (*Bremia lactucae* BREMLA) on lettuce and/or Downy mildew (*Peronospora destructor* PERODE) on onion and/or leek and/or any fungal disease on headed cabbage
Any fungal diseases of cereals and other grasses	Fusarium (*Fusarium* sp. FUSASP) on cereals and/or Powdery mildew (*Blumeria graminis* f. sp. *tritici* ERYSGT) on cereals and/or Septoria leaf blotch (*Zymoseptoria tritici* SEPTTR) on cereals
Any *Botrytis* species, any crops[a]	Botrytis (*Botrytis cinerea* BOTRCI) on strawberry and/or on tomato and/or on grapevine

[a]This is applicable for countries or regions with major uses for *Botrytis*. If an applicant requests authorization in countries or regions with only minor uses for *Botrytis*, representative uses on the first four fields of use are sufficient for an extrapolation to all fungicides.

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for one representative use, the results could be extrapolated to all crops belonging to the same field of use. Also, extrapolations to less challenging crop-disease combinations can be considered. If the benefit can be demonstrated in all five fields of use, the results can be extrapolated to all crop-fungicide combinations. However, particular attention should be paid to additional specific national requirements where they exist.

The PPP used in trials should be selected with care, according to the representative uses tested to allow the results from one fungicide to be extrapolated to all fungicides.

4.2 | Preserving/maintaining spray mix properties

If this is the only function claimed for an adjuvant, trials should be conducted with one or more active substance(s) making it possible to highlight the improvement of this function on one or more representative crop/disease combination(s) as described for point 4.1. If a benefit can be demonstrated for a specific representative use, the results could be extrapolated to all fungicides for this specific function.

If multiple claims are made for a specific adjuvant (e.g. maintaining spray mix properties and improving the retention or the spread), efficacy trials should be conducted in accordance with the representative uses as proposed for 4.1. In such cases, it can be useful to simultaneously test the preservation of the spray mix properties by using one or more active substance(s) that can highlight the improvement of this function in these trials.

4.3 | Improving 'wash-off' resistance

If 'improvement of wash-off resistance (rainfastness)' is claimed, specific efficacy trials are only useful if this function is the only one claimed. In such cases, trials should be conducted with one or more active substance(s) making it possible to highlight the improved wash-off resistance on one or more representative crop and pest target combination(s) such as described in point 4.1, and trials can be conducted under protected conditions. However, if 'improvement of wash-off resistance' function is claimed in combination with other functions, its evaluation may be covered within combined trials that also assess other claimed properties of the product.

4.4 | Improving the speed or rate of penetration

The function 'improvement of the speed or rate of penetration' is particularly relevant for systemic or translaminar (mostly lipophilic) substances. If penetration enhancement is the only function claimed, efficacy trials should be conducted with a systemic or translaminar active substance on relevant representative other functions, its evaluation may be covered within combined trials that also assess other claimed properties of the product. Improving uses, such as described for point 4.1. If efficacy can be demonstrated for one specific representative use, the results could be extrapolated to all fungicides regarding the specific function claimed.

If multiple claims are made for a specific adjuvant (e.g. improvement of the penetration and retention or spread), efficacy trials should be performed in accordance with the representative uses as proposed for 4.1. In such cases it can be useful to simultaneously test penetration enhancement by using a systemic or translaminar active substance in those trials.

4.5 | Improving the quality of the spray mix

If this function is claimed, it may be useful to confirm that the adjuvant has no negative impact on the effectiveness of the fungicide by conducting efficacy trials.

5 | ADJUVANTS IN ASSOCIATION WITH HERBICIDES

Effectiveness and crop safety trials should be conducted as described in EPPO PP 1/291.

5.1 | Improving the penetration, retention or spread on the target surface

5.1.1 | Effectiveness trials

For this function, the effectiveness of the adjuvant depends largely on the properties of the active substance. As such, herbicidal active substances can be subdivided into four classes according to their solubility and compatibility with adjuvants (see Appendix 1: Tables A1–A5) (CEB N°DT22, 2014):

Class 1: Active substances with low water solubility: These work well with oils and certain wetting agents.
Class 2: Active substances with medium water solubility: These work well with wetting agents, but only have limited compatibility with oils.
Class 3: Active substances with high water solubility: These work well with adjuvants that have the following physical properties: 'surfactants with a

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high HLB' (Hydrophilic Lipophilic Balance) and/or 'humectants'.

Class 4: Auxin-like active substances: These come in the form of salts or esters. The latter is highly lipophilic, the former (amine salts) slightly less so. They penetrate easily into the plant, and consequently neither is particularly influenced by the use of an adjuvant.

If the benefit of the adjuvant has been demonstrated for a single active substance within *one* class, the results can be extrapolated to *all* active substances belonging to the same class. If the benefit of the adjuvant has been demonstrated for at least Classes 1–3, the results can be extrapolated to *all* (post-emergence) herbicides. Justifying a benefit for active substances belonging to class 4 might not always be possible. For Class 4, such trials are only required when a specific authorization is sought for an auxin-like active substance/adjuvant combination.

Certain active substances have not been included in the above four defined classes – see Appendix 1: Table A5. In these instances, use with adjuvants is of little or no interest due to the risk of phytotoxicity to the crop. Extrapolation between these active substances is unlikely. If necessary, the benefit for such an adjuvant/herbicide combination should be demonstrated on a case-by-case basis.

Although some active substances might no longer be approved, old trial data conducted with these can still be used to support the use of adjuvants.

5.1.2 | Selectivity trials

For the improvement of *penetration, retention or spread on the target surface*, selectivity trials should be conducted on a 'worst-case scenario'. These should be conducted on a range of at least 4 representative crops that are known to be highly sensitive to phytotoxic effects, for example, durum wheat (*Triticum durum* TRZDU); maize (*Zea mays* ZEAMX); beet (*Beta vulgaris* BEAVX); oilseed rape (*Brassica napus* BRSNN) or green peas (*Pisum sativum* PIBSX). However, particular attention could be given to the risk of phytotoxicity on vegetable crops, for example, Chinese cabbage (*Brassica rapa* subsp. *pekinensis* BRSPK), leafy vegetable crops (3LEAC and 3LFBC) or umbelliferous vegetable crops (3UMBC). The tested active substance should be chosen based on its level of phytotoxicity. If the herbicide-adjuvant combination leads to unacceptable phytotoxicity symptoms on one of these crops (i.e. significant enhancement of the phytotoxicity of the herbicide by addition of the adjuvant), the phytotoxic risk assessment should be further refined by testing additional crops.

5.2 | All other adjuvant functions

5.2.1 | Effectiveness trials

For all other adjuvant functions, specific trials are only useful if the function is the only one claimed. For the improvement of 'wash-off' resistance and the preservation of the spray mix properties, the benefit of an adjuvant/herbicide combination should be demonstrated on a case-by-case basis. For the improvement of the quality of the spray mix, it is useful to ensure that the adjuvant has no negative impact on the effectiveness of the herbicide by conducting efficacy trials.

5.2.2 | Selectivity trials

For all other adjuvant functions, specific selectivity trials are only useful if the function in question is the only one claimed, and if symptoms of phytotoxicity have been observed in the efficacy trials at the N+n rates (being the intended dose rates of both the PPP and the adjuvant) of the herbicide/adjuvant preparation.

6 | PLANT GROWTH REGULATORS

Taking into account the specificity of the active substances concerned, no representative uses can be defined. Effectiveness and selectivity trials should be conducted *on any major crops* that generally require the use of growth regulators to demonstrate the effect of the adjuvant.

7 | DATA PRESENTATION

Data should be presented in a format similar to that used for applications for PPPs. The initial evaluation of the adjuvant's properties should follow EPPO Standard PP 1/291, with reference to Section 2. Efficacy trials should be performed in accordance with relevant EPPO PP 1 Standards, as well as EPPO Standard PP 1/291. The resulting reports should comply with EPPO Standard PP 1/181 *Conduct and reporting of efficacy evaluation trials, including good experimental practice* and include a detailed and critical assessment of the data.

REFERENCE

Commission des Essais Biologiques (CEB) - Végéphyl, Technical Document N°DT 22 (2014) *Recommandations concernant l'expérimentation d'un adjuvant en vue de préciser son domaine d'utilisation* (Recommendations regarding the testing of an adjuvant to specify its field of use).

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APPENDIX 1 - HERBICIDAL ACTIVE SUBSTANCES ACCORDING TO THEIR SOLUBILITY AND COMPATIBILITY WITH ADJUVANTS[1]

TABLE A1 Class 1, Active substances with low solubility in water.

Chemical family	Active substances
Aryloxyphenoxypropionate (FOPs), Cyclohexanedione (DIMs)	Clethodim
	Clodinafop
	Cycloxydim
	Cyhalofop-Butyl
	Diclofop
	Fenoxaprop-P
	Fluazifop-P
	Pinoxaden
	Propaquizafop
	Quizalofop-P
	Quizalofop-P-Ethyl
	Quizalofop-P-Tefuryl
Oxynils	Bromoxynil ester
	Ioxynil ester
Others	Carfentrazone-Ethyl
	Desmedipham
	Ethofumesate
	Florpyrauxifen-Benzyl
	Linuron
	Metamitron
	Metribuzin
	Phenmedipham
	Picolinafen
	Pyraflufen-Ethyl
	Pyridate

TABLE A2 Class 2, Active substances with medium solubility in water.

Properties	Active substances
ALS inhibitors	Amidosulfuron
	Azimsulfuron
	Bensulfuron
	Chlorsulfuron
	Flazasulfuron
	Florasulam
	Flupyrsulfuron-Methyl
	Foramsulfuron
	Imazamox
	Iodosulfuron
	Mesosulfuron
	Metosulam
	Metsulfuron-Methyl
	Nicosulfuron
	Penoxsulam
	Propoxycarbazone
	Prosulfuron
	Pyroxsulam
	Rimsulfuron
	Sulfosulfuron
	Thifensulfuron-Methyl
	Tribenuron
	Tritosulfuron
HPPD inhibitors	Isoxaflutole
	Mesotrione
	Sulcotrione
	Tembotrione
Other	Asulam

[1]This list is only indicative. It is included in the Standard for information purposes and is subject to changes depending on active substance new approvals and withdrawals.

TABLE A3 Class 3, Active substances with high solubility in water.

Properties	Active substances
Water soluble	Amitrole
	Diquat
	Glufosinate
	Glyphosate

TABLE A4 Class 4, Auxin-like active substances.

Properties	Active substances
Auxin-Mimics	2,4-D
	2,4-DB
	MCPA
	MCPB
	Aminopyralid
	Clopyralid
	Dicamba
	Dichlorprop-P
	Halauxifen
	Fluroxypyr
	Mecoprop
	Mecoprop-P
	Picloram
	Quinmerac
	Triclopyr

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TABLE A5 Other active substances for which extrapolation is unlikely to be possible and benefit should be demonstrated on a case-by-case basis.

Active substances
Aclonifen,
Beflubutamid
Benfluralin
Bromoxynil phenol
Carbetamide
Chloridazon
Chlorotoluron
Chlorpropham
Cinidon Ethyl
Clomazone
Diflufenican
Dimethachlor
Dimethenamid-P
Flufenacet
Flumioxazin
Flurochloridone
Flurtamone
Isoproturon
Isoxaben
Lenacil
Metazachlor
Metobromuron
Napropamide
Oryzalin
Oxadiargyl
Oxadiazon
Oxyfluorfen
Pelargonic Acid
Pendimethalin
Pethoxamid
Propyzamide
Prosulfocarb
S-Metolachlor
Tri-Allate