

Establishing Safe and Effective Cocoa Pesticides

Version: 14 August 2015

Criteria for listing pesticides in Appendix 3

A. List of strategic/registered pesticides for use in cocoa which:

- have relevant EU/Japanese/US/Codex import tolerances; some EU MRL^s (mg.kg⁻¹) may remain tMRL^s and their status should be checked regularly; those listed here refer to “Cocoa (fermented beans)” as in Reg. (EC) No 396/2005.
- show acceptable levels of low mammalian toxicity and environmental impact and formulations *do not* belong to the highest toxicity group WHO/EPA Class I (apart from rodenticides and fumigants supplied as professional products).
- have proven efficacious against an important pest species of cocoa: with registrations in at least two regional cocoa growing countries and publication of trial results in (preferably refereed) scientific literature.

B. Compounds to be used with great CAUTION (limited lifetime, restricted markets, etc).

These active substances:

- are still registered in at least one OECD country (EU, USA, Canada, Australia, Japan...)
- have accepted MRLs in some markets, but not others and/or ...
- are likely to be considered for substitution in the future in EU, but ...
- have shown demonstrable efficacy in at least one regional cocoa growing country
- AI do not belong to WHO/EPA toxicity Class I (and must be Class II formulations or better): apart from rodenticides and fumigants supplied as professional products.

C. Lists of experimental control agents for possible future inclusion in category ‘A’

These control agents:

- include new active substances currently under registration or registered in at least one OECD country and may be efficacious against an important cocoa pest category; they may be subject to current field testing in at least one country and conform to criteria in category ‘A’
- have relevant Codex, EU, Japanese and/or US import tolerances, or are likely to be submitted;
- formulations *do not* belong to WHO/EPA toxicity Class I and preferably in Class III or better

Note: from March 2015 in the interests of streamlining research, compounds will be listed, that have been considered experimentally, but no further development is planned.

D. Pesticides that MUST NOT BE USED FOR COCOA

Substances that have been recorded as used on cocoa (e.g. by the ECA/CABI/CAOBISCO project), but have been rejected by major importing countries (usually for toxicological/ eco-toxicological reasons) and/or have no residue tolerances in major markets.

Notes:

1. Trade names are not used in this edition and several products contain mixtures of AI.
2. Since residues can arise from any point in the supply chain, an AI can only be placed in ONE of the categories A, B, C or D.
3. Compounds for inclusion continue to be reviewed, and special care should be taken with any compound that remains on the “pending” (P) list. Compounds labelled ‘M’ are subject to the 2013 moratorium in the EU due to risk of bee toxicity.
4. For historical reasons, a number of compounds are recorded as being used on cocoa and have MRL values that are above the default value, yet are not on the list of substances on Annex 1. It is important to appreciate that the authorisation of a pesticide on the EU market and the harmonised pesticide residue legislation (396/2005/EC, which includes MRLs for imported cocoa) are essentially two separate legal issues.
5. In principle, procurement agencies and cocoa growers are encouraged to consider carefully any products containing any AI listed in Appendix 3B and they should not be developed for new markets. However this list is a ‘mixed bag’ of compounds that include those:
 - that have import tolerances in some markets but not others
 - for which no company has considered it economic to prepare and submit an adequate dossier for inclusion in Annex 1 in the EU.
 - AI with known issues, but tMRL have been set in the interests of cocoa production and market competition, where a case has been made for continued use of compounds in at least 1 jurisdiction.

As in 3rd edition of: *Pesticide Use in Cocoa*: Version: 14 Aug. 2015

A: Lists of strategic / recorded active substances for use in cocoa

These AI conform to the criteria described in Chapter 7

(i) black pod diseases

Active ingredients	MoA group	EU status	EU MRL	JP MRL
benalaxyl (all isomers incl. ~M)	A1	Y *	0.1	(0.01)
copper hydroxide	M1	Y	Cu ions:	A
copper oxide	M1	Y	50.0	A
copper oxychloride	M1	Y		A
fosetyl aluminium	P	Y	2.0	0.05
dimethomorph (DMM)	H5	Y	0.05	(0.01)
mandipropamid	H5	Y	0.02	(0.01)
metalaxyl (unresolved)	A1	Y μ *	0.1	0.2 [§]
metalaxyl-M (mefenoxam)	A1	Y μ	0.1	0.2 [§]

(ii) insects

Active ingredients	MoA group	EU status	EU MRL	JP MRL
As sprays (mostly against Miridae)				
acetamiprid	4A ξ	Y	0.1	(0.01)
bifenthrin	3	Y	0.1	0.1 [§]
cypermethrin – all isomers:	3	Y *	0.1	
cypermethrin (α isomer) β	3	Y *	0.1	0.03
deltamethrin β	3	Y	0.05	0.05 δ
lambda-cyhalothrin β	3	Y *	0.05	0.01
Imidacloprid	4A	M **	0.05	0.05 [§]
teflubenzuron π	15	Y	0.05	0.02
thiacloprid	4A ξ	Y	0.05	0.02
thiamethoxam	4A	M *	0.05	0.02 [§]

(iii) weeds and stump treatments

Active ingredients	MoA group	EU status	EU MRL	JP MRL
triclopyr σ	O	Y	0.1	0.03
glyphosate salts	G	Y	0.1	0.2

(iv) stored produce etc.

Active ingredients	MoA group	EU status	EU MRL	JP MRL
aluminium phosphide ***	24	Y	0.05	(0.01)
magnesium phosphide ***	24	Y	0.05	(as PH ₃ : phosphine)
sulfuryl fluoride	8	Y	10	(as fluoride ion)
pyrethrins (pyrethrum) for fogging	3	Y	0.5	(0.01)
pyrethroids (treating sacks, etc.)	3	if Y as above and registered for purpose		
Permitted (EU) rodenticides ***:	(anti-coagulant – see text)			
bromadiolone, difenacoum		Y	(0.01)	(0.01)

* High residue levels have been found in imported produce to the EU and/or Japan (**: >10 cases since 2008)

*** High mammalian toxicity: to be used only by qualified personnel

§ Now to be tested in Japan after removal of shell (testa); Japan MRLs in brackets assumed to be at default.

M Current moratorium on use in the EU due to suspected bee toxicity

α No MRL given in Japan and copper is exempt in the USA

μ Metalaxyl includes mixtures of all constituent isomers including metalaxyl-M (sum of isomers)

β Registered (widely used) for cocoa pod borer control in Indonesia

ξ Cyano-substituted neo-nicotinoid

δ Includes deltamethrin and tralomethrin (as total)

π Usually sold as a mixture (co-formulated with a pyrethroid)

σ Mostly for stump treatments in CSSVD eradication

B: Compounds to be used with great CAUTION (limited lifetime, restricted markets, etc.)

These AI:

- have permitted MRLs in some markets, but not others and/or ...
- may have **temporary** (tMRL^s) or strong possibility of phasing-out within coming years, but ...
- have shown demonstrable efficacy in at least one regional cocoa growing country
- do not belong to WHO/EPA toxicity Class I (apart from rodenticides and fumigants supplied as professional products)

(i) diseases

Active ingredients		MoA group	EU status	EU MRL	JP MRL
chlorothalonil	δ	M5	Y	0.1	0.05

(ii) insects

Active ingredients		MoA group	EU status	EU MRL	JP MRL
beta-cyfluthrin	β, τ	3	Y	0.1	0.1
clothianidin	χ	4A	M	0.05	0.02 [§]
diazinon		1B	N	0.02	0.05
dimethoate		1B	Y	0.05	0.05
chlorpyrifos (ethyl)	β	1B	Y *	0.1	0.05
fenobucarb (BPMC)		1A	N *∅	(0.01)	0.02
malathion		1B	N *	0.02	0.5
novaluron	π	15	N	(0.01)	(0.01)
pirimiphos methyl		1B	Y **ε	0.05	0.05

Useful especially for termite control

fipronil	γ	β	2	M	0.005 γ	0.01
----------	---	---	---	---	---------	------

(iii) weeds

Active ingredients		MoA group	EU status	EU MRL	JP MRL
2,4-D dimethylamine salt		O	Y *	0.1	0.01
picloram		O	Y	0.01 (T)	(0.01)
paraquat	δ	D	N	0.05 (T)	0.05

(iv) stored produce etc.

Fumigants ***	MoA group	EU status	EU MRL	JP MRL
methyl bromide μ (as inorganic bromide ion)	8A	N	0.01 70.0	& US: 50.0
Rodenticides ***	(anti-coagulant – see text)			
brodifacoum,		N	(0.01)	(0.01)
warfarin (coumaphene)		N	(0.01)	(0.01)

* High residue levels have been found in imported produce to the EU and/or Japan (**: >10 cases since 2008)

*** High mammalian toxicity: to be used only by qualified personnel

β Registered for cocoa pod borer control in Indonesia

τ Toxicity of AI in class 1b, but still registered in some jurisdictions

γ Fipronil (sum fipronil + metabolites). Five degradation products are known, depending on the mode of break-down: fipronil-sulfone, fipronil-sulfide, fipronil-desulfinyl, fipronil-amide, and fipronil-detrifluoromethyl-sulfinyl. Fipronil is not permitted for use as spraying in the EU or USA and has generally permitted only for targeted applications such as baiting, in-furrow and seed treatments; however, it has been registered for spraying CPB (above) and mirids in 2 African countries.

ε Use of pirimiphos methyl in cocoa is no longer defended by Syngenta; zero tolerance (*i.e.* LOD) for this AI in Australia.

δ US MRL of 0.05

χ clothianidin appears to have had little use in cocoa to date, but for residue analysis note: Naeun et al (2003)ⁱ

μ Restricted under the Montreal Protocol; to be phased out by EPA in the USA and most other countries (by 2017)

π Usually sold as a mixture (co-formulated with a pyrethroid)

∅ P pesticides are used outside the EU but for which no toxicological data and no MRLs have been notified for inclusion in 396/2005/EC Annex III (neither by the member states, in the form of import tolerances, nor by third countries). Such compounds may have a clear purpose outside Europe (*e.g.* fenobucarb: which is widely used for control of hemipteran pests of rice in Asia, and has also been applied to cocoa in certain countries).

C: Lists of experimental control agents (for possible future inclusion under Appendix 3A)

Note: this list is for guidance, may not be exhaustive and will be subject to changes. All these AI:

- are known to have available products with acceptable MRLs for other agricultural produce
- are subject to current or recent field testing and may well conform to criteria in category '3A', described in Chapter 7, when it is established that they are efficacious against important pests.
- do not belong to WHO/EPA toxicity Class I and preferably in class III or better

(i) diseases (Ω: effective for Oomycetes?)

Active ingredients	MoA group	EU status	EU MRL	JP MRL
flumorph, benthiavalicarb, iprovalicarb, valifenalate (Ω)	H5 (prev. F5)	Y	0.1	
Strobilurins including:				
azoxystrobin	C3	Y	0.1	(0.01)
pyraclostrobin	C3	Y		
pyrimethanil	D1	Y		
ametoctradin (Ω)	C8	Y		
other MoA groups to consider testing:	B3, B5, C4 (Qil fungicides), U5			
Fungi such as <i>Trichoderma</i> spp.	MCA	-		

(ii) insects

Active ingredients	MoA group	EU status	EU MRL	JP MRL
a. sucking insects: mirids (including <i>Helopeltis</i> spp.)				
emamectin benzoate	6	Y	0.02	
other IGRs:				
chlorfluazuron, lufenuron, etc.	15	Y		
Non-NNI nAChR agonists				
sulfoxaflor	4C	Y	0.05	(0.01)
pymetrozine	9B	Y		
spirotetramat	23	Y	0.1	
entomopathogenic fungi? (for R&D)	MCA	-		
b. Lepidoptera : cocoa pod borer, etc.				
emamectin benzoate	6	Y	0.02	
IGRs	15	if Y (as above)		
Ryanodine receptor molecules (diamides):				
chlorantraniliprole (CTPR)	28	Y	0.1	0.08 [§]
flubendiamide, cyantraniliprole	28	Y		
granulosis viruses? (for R&D)	MCA	-		

(iii) weeds

Active ingredients	MoA group	EU MRL	JP MRL
Permitted contact herbicides (if required?)			
Note: diquat	D	Y	0.1 (0.01)

(iv) stored produce

Active ingredients	MoA group	EU MRL	JP MRL
Diamides (as above)	28		

§: now to be tested in Japan after removal of shell (testa)

No further development planned for cocoa declared for: methoxyfenozide, spinosad, spinetoram

D: Pesticides that MUST NOT BE USED for cocoa

Active ingredients	MoA group	EU, MRL status ¹ and notes
Insecticides		
acephate	1B	N
amitraz	19	N \hat{J}
aldrin	2	N Φ Class 1
azinphos-methyl	1B	N Class 1
butocarboxin	1A	N
cabaryl	1A	N
carbofuran	1A	N Class 1 as spray formulation
carbosulfan	1A	N
cartap	4C	N
chlordane	2	N Φ
cyhalothrin (unresolved)	3	N α
cyhexatin (acaricide)	12B	N \hat{J}
DDT	3	N Φ malaria control: with IRS – MRLs are 0.5 ppm (EU), 0.15 ppm (Russia) 1.0 ppm (USA) 0.05 ppm (Japan)
dichlorvos (DDVP)	1B	N Class 1
dieldrin	2	N Φ Class 1
dioxacarb	1A	N
endosulfan	2	N Φ (MRL 0.1 mg/kg) ** Class 1
endrin	2	N Φ Class 1
fenthion	1B	N
fenitrothion	1B	N * (EU MRL 0.05 mg/kg)
fenvalerate	3	N **
hexachlorocyclohexane (HCH): all isomers including lindane (a.k.a. gamma BHC)	2	N * Φ
isoprocarb (MIPC)	1A	N \emptyset
methidathion	1B	N
methyl-parathion (= parathion-methyl)	1B	N * Class 1
methomyl	1A	Y β Class 1
methamidophos	1B	N
methidathion	1B	N
monocrotophos	1B	N Class 1
nicotine	4B	N Class 1
permethrin	3	N
profenfos	1B	N *
promecarb	1A	N Class 1
propoxur	1A	N
terbufos	1B	N Class 1
thiodicarb	1A	N
triazophos	1B	N
tralomethrin	3	N
trichlorfon	1B	N
Herbicides		
ametryn	C1	N
atrazine	C1	N*
chlorpropham	K2	Y*
fomesafen	E	N
MSMA (methyl arsenic acid)	Z	N
2,4,5-T	O	N \hat{J}

Appendix 3b (continued)

Fungicides

benomyl	B1	N δ
captafol	M4	N Ĵ
hexaconazole	G1	N
pyrifenoX	G1	N
triadimefon	G1	N
tridemorph	G2	N
zineb	M3	N

Stored produce

allethrin (esbiothrin)	3	N
bioresmethrin	3	N
ethylene dichloride, ~ dibromide		N
fenitrothion	1B	N * (EU MRL 0.05 mg/kg)
isoprocarb (MIPC)	1A	N ø
permethrin	3	N **
resmethrin	3	N
tetramethrin	3	N

Rodenticides

arsenic compounds e.g. sodium arsenite	inorganic	N
cyanides: calcium, hydrogen, sodium	inorganic	N
sodium fluoroacetate (1080)	inorganic	N ø

¹ compounds not included on 91/414/EEC Annex 1 and are not thought to be essential for cocoa production. However, it is important to note that several of these compounds have MRL above the default level.

* High residue levels have been found in imported produce to the EU and/or Japan (**: >10 cases since 2008)

Cocoa growers are strongly advised to stop using any products containing AI on this list. They may have been used previously for cocoa pests, but there should now be recommended substitutes: if this is not the case please notify the author.

They include:

Φ All pesticides listed in the Stockholm (persistent organic pollutant or POP) Convention. In addition to the AI listed above this includes compounds such as: chlordecone (kepone), heptachlor, mirex, toxaphene, etc. (never recorded on cocoa).

● obsolete and banned compounds (e.g. promecarb).

α Note: unresolved cyhalothrin is not included on Annex 1, but the isomer lambda-cyhalothrin (used for mirid control) is permitted and registered in cocoa growing countries. Gamma-cyhalothrin is pending approval.

Ĵ Compounds specifically listed at LOD for cocoa in Japan

ø P pesticides are used outside the EU but for which no toxicological data and no MRLs have been notified for inclusion in 396/2005/EC Annex III (neither by the member states, in the form of import tolerances, nor by third countries). Such compounds may have a clear purpose outside Europe (e.g. fenobucarb and isoprocarb: which are widely used for control of hemipteran pests of rice in Asia, and have also been applied to cocoa in certain countries).

β Also breakdown product of thiodicarb: which is not approved in the EU.

δ Breaks down into the permitted compound carbendazim.

These lists may not be exhaustive: they have been based on ICCO records and include the findings of CABI executed projects in collaboration with ECA/CAOBISCO (see *Global Research on Cocoa*, CABI, June 2008).

ⁱ Nauen R, Ebbinghaus-Kintscher U, Salgado VL, Kausmann M (2003) Thiamethoxam is a neonicotinoid precursor converted to clothianidin in insects and plants. *Pesticide Biochemistry and Physiology* 76: 55-69.