

**Evaluation Manual
for the Authorisation
of Plant protection products and Biocides
according to Regulation (EC) No 1107/2009**

NL part

Plant protection products

**Chapter 6 Fate and behaviour in the environment:
behaviour in soil; persistence**

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**Board
for the Authorisation
of Plant protection products and Biocides**

Chapter 6 Fate and behaviour in the environment; behaviour in soil; persistence

Category: Plant protection products

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GENERAL INTRODUCTION

This chapter describes the data requirements for estimation of the persistence in the soil of a Plant Protection Product and its active substance and how reference values are derived in the NL framework (§2 - §2.5).

Substances that are approved under Regulation (EC) No 1107/2009 [1] and were approved under Directive 91/414/EEC [2] are included in Commission Implementing Regulation (EU) No 540/2011 [3].

The chapter describes the procedures following the data requirements as laid down in Commission Regulation (EU) No 283/2013 for active substances and in Commission Regulation (EU) No 284/2013 for plant protection products. These data requirements apply for active substances submitted after 31 December 2013 and for plant protection products submitted after 31 December 2015.

A concept guidance is available on the interpretation of the transitional measures for the data requirements for chemical active substances according to Regulation (EU) No 283/2013 and Regulation (EU) No 284/2013 (SANCO/11509/2013 – rev. 0.1).

For further information on the former data requirement as laid down in Commission Regulation (EU) No 544/2011 for active substances and in Commission Regulation (EU) No 545/2011 we refer to the Evaluation Manual for Authorisation of plant protection products according to Regulation (EC) No 1107/2009 version 1.0.

2. NL FRAMEWORK

The NL framework (§2 - §2.5) describes the authorisation procedure for plant protection products based on existing substances, included in Commission Implementing Regulation (EU) No 540/2011 [3], and new active substances.

A new substance is a substance not authorised in any of the Member States of the EU on 25th of July 1993.

The plant protection product that contains such substances may be authorised if the criteria laid down in Regulation (EC) No 1107/2009 [1] are met, also taking into account the national stipulations described in the Bgb (Plant protection products and Biocides Decree) [4]. The evaluation dossiers must meet the requirements in Commission Regulation (EU) No 283/2013 [5] and Commission Regulation (EU) 284/2013 [6] implementing Regulation (EC) No 1107/2009 [1]. (see Application Form and corresponding instructions).

A Member State may deviate from the EU evaluation on the basis of agricultural, phytosanitary and ecological, including climatological, conditions which are specific for the Netherlands.

The NL framework describes the data requirements (§2.2), evaluation methodologies (§2.3), criteria and trigger values (§2.4) for which specific rules apply in the national approval framework or when the national framework has been elaborated in more detail than the EU framework.

The NL procedure described in §2 - §2.5 of this chapter can also be used for evaluation of a substance for approval, and consequently inclusion in Commission Implementing Regulation (EU) No 540/2011 [3] where no EU procedure has been described.

2.1. Introduction

This chapter describes the data requirements and evaluation methodologies for persistence in the soil for which specific rules apply in the national approval framework or when the national framework has been elaborated in more detail than the EU framework.

The risk of persistence of plant protection products in the soil is assessed to prevent that products that present an unacceptable environmental risk reach the NL market.

The questions from the part 'Fate and behaviour', raised in the EU part §1.2.1 and 1.2.2, are relevant for the persistence (residence time) and accumulation of Plant protection products in the soil. Data concerning the nature of the metabolites and the degradation rates of active substance and metabolites are covered. These data are also used to assess the risk of leaching to groundwater (see Chapter 6 Fate and behaviour in the environment; behaviour in soil; leaching to groundwater).

Ecotoxicological data coming under the data requirements for other aspects than persistence are used in the higher tier persistence evaluation, when they are compared with the predicted accumulated soil concentrations ($PIEC_{soil} + PEC_{soil,plateau}$) (see EU-part §1.3.2). This concerns all data, when available, for soil dwelling organisms (i.e. soil dwelling arthropods, earthworms, soil micro-organisms, other soil macro-organisms (see Chapters 7 Ecotoxicology; terrestrial; soil organisms and non targets).

2.2. Data requirements

The data requirements for chemical plant protection products are in agreement with the provisions in EU framework (see §1.2 of the EU part). NL-specific data requirements and further clarifications of the EU data requirements are given in the text below.

Experiments carried out after 25 July 1993 must have been carried out under GLP.

There may be no doubt about the identity of the tested product or the purity of the tested substance for each study.

The studies must be carried out in compliance with the applicable guidelines. A review of the guidelines and whether or not these are required for particular fields of use is given in Appendix A to Chapter 6.

NL-specific data requirements and further clarification of EU data requirements

The soil types for determination of the route and rate of transformation (A7.1.1.1, A7.1.1.2. and P09.1.1.1a) are preferably chosen from soil types 1, 2 and 3 from Annex A7.1a to the supplementary instruction of the Dutch Application Form; this Annex is added to this Chapter as Appendix 1.

Field studies (A7.1.1.2.2 and P9.1.1.2b - d) should be carried out under climatological and soil conditions that are comparable to NL conditions. Information about NL soil conditions is given in GeoPEARL [7, 8]. Evaluation of the suitability of field studies as regards the other aspects is based on expert judgement.

2.3. Risk assessment

The soil persistence evaluation of plant protection products follows the EU framework (see §1.3 of the EU part; there also specific aspects that have not been elaborated in the EU framework, or for which in practice other working agreements are used, are elaborated in more detail.)

Further elaboration of EU evaluation framework

No European method for calculation of the concentration in the soil has been elaborated for seed dressings or treated propagation material; the calculation method presented in Appendix 2 to this chapter is therefore proposed as further elaboration. The method is briefly summarised below.

A *homogeneous distribution* of the active substance in spherical spheres of influence around the seed is assumed. Analogous to the distribution depth for a spray formulation, it is assumed that the radius of the *sphere of influence* is 5 cm. In the scenario proposed. For drilling/planting of larger seeds at ≥ 5 cm depth, e.g., pilled beet seed or seed potatoes, the sphere of influence has the form of a full spheroid. A maximum volume of 500 m³ per ha is assumed as maximum volume of the sphere of influence of the seeds.

The calculation method has been elaborated in Appendix 2 to this chapter.

In the appendix 2 some other exceptions are mentioned that are Dutch specific for soil. Pending the new guidance on treated seeds the $PEC_{s,sphere}$ is a Dutch specific approach. The approach is included to provide additional information. Since PEC_{soil} is not a Dutch specific aspect the EU approach is sufficient for registration.

2.4. Approval

The evaluation of products on the basis of existing active substances already included in Commission Implementing Regulation (EU) No 540/2011 [3] or new substances has been laid down in Regulation (EC) No 1107/2009 [1]. Where no European methodology is agreed upon, a national methodology is applied as described in the Plant protection product and Biocides Decree (Bgb) [4].

2.4.1. Criteria and trigger values

For the criteria and trigger values for soil persistence for the national authorisation reference is made to the EU part (§1.4.1).

2.4.2. Decision making

For decision making for soil persistence for the national authorisation reference is made to the EU part (§1.4.2).

2.5. Developments

Wipfler, E.L., A. Cornelese, A. Tiktak, T. Vermeulen and W. Voogt, 2013 (in prep). Scenarios for exposure of aquatic organisms to plant protection products in the Netherlands, part 3: Soil-bound crops in greenhouses, Wageningen, The Netherlands, Alterra, Alterra Report 2388.

3. APPENDICES

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Appendix 1 Overview of soil types to be used in the studies; pre-treatment of the soil

A brief description of the five soil types most relevant for the Netherlands is given below. The margins for the different properties were chosen in such a way that there is a large degree of overlap with the soil requirements laid down in the BBA Merkblätter.

Data from experiments carried out outside the Netherlands with soil types prescribed in the country in which the experiments were carried out will generally be acceptable, unless the selected soils differ on essential points from the specifications given below.

1. humous sandy soil with:

Clay (particles < 2 µm) content < 8%; organic matter content 4-8%; < 25% silt (2-50 µm); pH-KCl 4.5-6.0. (Partial overlap with BBA 2 = 'Sand').

2. loam, moderately low in humus with:

Clay content 12-25%; organic matter content 2-3%; pH-KCl 6.5-7.5.

(Partial overlap with BBA 3 = 'Sandiger Lehm' and 'Sandy Loam' and 'Silt Loam').

3. sandy soil, low in humus with:

Clay content < 8%; silt content < 50%, organic matter content < 2%; pH-KCl 4.5-7.0.

(Partial overlap with BBA 1 = 'Sand' and 'Agricultural Sand').

4. heavy clay soil, with low or moderate humus content with:

Clay content > 35%; organic matter content 2.0-4.5% (for arable land); pH-KCl 6.0-7.5.

(Partial overlap with 'Clay' or 'Clay loam').

5. peaty soil or peat soil with:

Minimum organic matter content dependent on clay content, viz., > 15% organic matter if the mineral fraction consists of particles > 2 µm only, or > 30% organic matter if the mineral fraction consists of clay only. Intermediate values to be interpolated according to clay content; pH-KCl 4.5-5.5. (Overlap with 'Muck Soil'.)

Description of the history of the soil, e.g. on last application of the Plant protection products is required; obviously for metabolism research soil should be used on which the chemical or structural analogues have not been applied for at least 5 years in order to avoid disturbing side-effects in the experiments. For soil fumigants a period of at least one year before sampling applies. Apart from that, no organic manure may have been applied to the soil during at least one year. The soil may, after fresh collection from the field, be stored for a maximum of 3 months at 4 °C. Storage at higher temperatures leads to shortening of the permitted storage periods (50 days at 10 °C, 30 days at 15 °C, and 20 days at 20 °C). Data on history, storage and pre-incubation should be included in the reports of the experiments. Soils may in no way be activated or manipulated, unless for studying a specific aspect. For laboratory research the soil is preferably freshly collected from the field, or otherwise from a well-drained temporary storage in the open air (maximum layer thickness 30 cm). Before use, the soil is rubbed through a sieve (2 mm), brought (and maintained) at a moisture content corresponding to a pF value of about 2.5, and stored for about 2 weeks under aerobic conditions (e.g. in plastic oxygen-permeable bags) at the temperature at which the measurements are to be carried out.

Appendix 2 Calculation $PIEC_{s,sphere}$ seed dressings and some NL exceptions

Summary

A method for calculating the PIEC of seed dressings is proposed in this note.

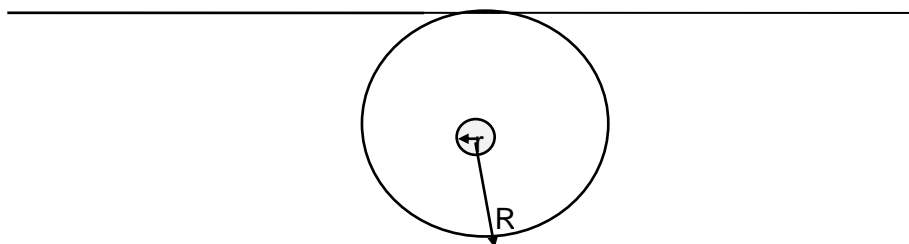
Drilling/planting of larger treated seeds at ≥ 5 cm depth, e.g., pilled beet seed, maize, potatoes or bulbs is assumed to have large influence on local exposure concentration in soil. A *homogeneous distribution* of the active substance in spherical spheres of influence around a seed is assumed for the calculation. Analogous to the distribution depth for a spray formulation it is assumed that the radius of the *sphere of influence* is 5 cm. The sphere of influence has the form of a full spheroid. For both scenarios a maximum volume of 500 m^3 is assumed.

General calculation method

Starting point in the evaluation of spray formulations is the homogeneous distribution of the active substance in the top 5 cm layer of the soil. For the calculation of the PIEC, spraying losses and interception are taken into account but disappearance routes such as evaporation, photochemical transformation and microbial degradation are not. The volume of soil with a layer thickness of 5 cm of a hectare is 500 m^3 , and the mass of the soil is $750 \cdot 10^3 \text{ kg}$ (at a bulk density of 1500 kg/m^3). The dose of active substance divided by the mass of the soil then yields a measure for the acute exposure of soil organisms (= PIEC).

The proposed calculation method for seed dressings of seeds with a diameter > 0.5 cm sown at 5 cm or larger depth is presented below (figure 1).

Figure 1. Sphere of influence of seeds > 0.5 cm sown at 5 cm depth.



Assumptions:

- Analogous to the depth (5 cm) that is applied in the calculation of a PIEC for a spray formulation, for seed dressings a sphere of influence of 5 cm around the seed is proposed.
- The seed dressing is fully released into the soil.
- A maximum size of the sphere of influence of 500 m^3 . Because at a higher seed density the spheres of influence will be overlapping, in that case a homogeneous distribution through the top 5 cm of the soil is assumed.

Scenario

The sphere of influence of seeds with a diameter > 0.5 cm sown at 5 cm depth or deeper

has the shape of a full **spheroid** (see figure 2). Because the size of the seed is not negligible, the volume of the seed must be deducted from the volume of the spheroid. The model parameters are described in Table 1.

The volume of a **round** seed is:

$$V_{\text{seed}} = \frac{4}{3} \pi r^3 \quad -5-$$

The volume of the sphere of influence of a seed is calculated as follows:

$$v = \frac{4}{3} \pi (R^3 - r^3) \quad -6-$$

where for R the radius of the seed is added to radius of the sphere of influence, thus

$$R = r + 0.05 \quad -7-$$

Volume and mass of the soil within the sphere of influence of n seeds per m² are then calculated. The total volume of the sphere of influence on one hectare of soil is bound to a maximum of 500 m³/ha and is calculated as follows:

$$V = \min[n \cdot v, 500] \quad -8-$$

The total mass of soil at a hectare within the sphere of influence of the seeds is then

$$M = \rho \cdot V \quad -9-$$

The dose of the seed dressing is then divided by the mass of soil within the sphere of influence of the seeds, which results in the PIEC at:

$$\text{PIEC} = 10^6 D / M \quad -10-$$

Table 1. Description of the parameters.

Input		
R	radius of the sphere of influence of the seed	m
r	radius seed	m
n	sowing density	ha ⁻¹
D	dose	kg a.s.· ha ⁻¹
ρ	dry bulk density of the soil	kg· m ⁻³
Intermediates		
v	volume of the sphere of influence of a seed	m ³
V _{seed}	volume of a seed	m ³
V	total volume of soil within the sphere of influence of the seeds on one hectare soil	m ³ · ha ⁻¹
M	total mass of soil within the sphere of influence of the seeds on one hectare soil	kg· ha ⁻¹
Output		
PIEC	Predicted Initial Environmental Concentration	mg a.s./ kg soil

Conclusions

The calculation of $PIEC_s$ via sphere of influence does in a three-dimensional way take into account which soil is/is not burdened with the active substance. The proposed method is based on the same starting points as those for the evaluation of spray formulations. Comparison with the classical method (homogeneous distribution over 5 cm soil) highlights that there are equal outcomes at high seed densities but that the $PIEC$ values are higher for low seed densities.

Flowerbulbs and PEC_s

For flower bulbs the seed dressing is not taken into account since the bulbs are almost completely and equally distributed over the topsoil. Since flower bulb are covered with approximately 5 soil, a soil layer of 10 cm (5 cm cover soil and 5 cm soil below) is used for PEC_{soil} calculations instead of 5 cm.

$PEC_{s,sphere}$ for potatoes

A product applied as tuber treatment can be dosed indoor or outdoor (attached to the sowing machine). Therefore, the spherical distribution model (see above) applies for this assessment. For potatoes, the $PIEC$ (mg/kg) for a tuber treatment is calculated as: application rate in kg/ha / (radial influence in $m^3/ha \times$ soil density in kg/m^3) $\times 10^6$.

In this case this corresponds to (application rate in kg/ha) / (38.71 or 83.62 $\times 1500$) $\times 10^6$, in which the value for the radial influence volume/ha is based on the following data:

- For both ware/starch potatoes and seed potatoes, a radius of 2.25 cm is assumed (diameter tuber large size class 4.5-5.5 cm).
- For seed potatoes a sowing density of **4.5 tonne/ha** is used, corresponding to 54.000 potatoes (12.000 potatoes/tonne). This leads to a volume of the radial influence of 83.62 m^3/ha .

For ware and starch potatoes a sowing density of **2.5 tonne/ha** is used, corresponding to 25.000 potatoes (10.000 potatoes/tonne). This leads to a volume of the radial influence of 38.71 m^3/ha .

Interception usage for grassland

If the proposed label does not explicitly exclude the application on first year grass, than two scenarios should be assessed: one scenario for first year grassland, where an interception value is used as presented in the table above for grass corresponding to the BBCH code specified in the GAP; one scenario for established grass using an interception value of 90%.

Link of DTG crops and crops in the interception tables

Crop related aspects of crop canopy spray interception used in the NL and spray drift from downward directed spray applications in field crops [9].

DTG crop code	DTG crop	FOCUS crop
1	Arable crops	
1.1	Potatoes	
1.1.1	-	
1.1.1.1	Seed potatoes	Potatoes
1.1.1.2	Ware potatoes	Potatoes
1.1.1.3	Starch potatoes	Potatoes
1.2	Beetroot	
1.2.1	-	
1.2.1.1	Sugar beets	Sugar beets
1.2.1.2	Fodder beets	Sugar beets
1.3	Cereals	

1.3.1	Winter cereals	
1.3.1.1	Winter wheat	Cereals
1.3.1.2	Winter barley	Cereals
1.3.1.3	Winter rye	Cereals
1.3.1.4	Triticale	Cereals
1.3.1.5	Spelt	Cereals
1.3.1.6	Canary grass	Cereals
1.3.2	Spring cereals	
1.3.2.1	Spring wheat	Cereals
1.3.2.2	Spring barley	Cereals
1.3.2.3	Spring rye	Cereals
1.3.2.4	Oats	Cereals
1.3.2.5	Teff	Cereals
1.3.3	Other cereals	
1.4	Maize	
1.4.1	-	
1.4.1.1	Silage maize	Maize
1.4.1.2	Seed maize	Maize
1.4.1.3	Corn cob mix	Maize
1.4.1.4	Corn cob silage	Maize
1.5	Pulses	
1.5.1	Dry-harvested peas	
1.5.1.1	Marrowfat peas	Peas
1.5.1.2	Yellow peas	Peas
1.5.1.3	Grey peas	Peas
1.5.1.4	Green peas	Peas
1.5.1.5	Lentils	Peas
1.5.1.6	Maple peas	Peas
1.5.1.7	Brown marrowfat	Peas
1.5.1.8	Sugar snaps	Peas
1.5.1.9	Chickpeas	Peas
1.5.2	Dry-harvested beans	
1.5.2.1	Brown bean	Beans (field+vegetable)
1.5.2.2	Yellow bean	Beans (field+vegetable)
1.5.2.3	Pinto bean	Beans (field+vegetable)
1.5.2.4	White bean (haricot)	Beans (field+vegetable)
1.5.2.5	Soya bean	Beans (field+vegetable)
1.6	Grass seed crops	
1.6.1	Ryegrass	
1.6.1.1	English ryegrass	Grass
1.6.1.2	Italian ryegrass	Grass
1.6.1.3	French ryegrass	Grass
1.6.1.4	Westerwold ryegrass	Grass
1.6.1.5	Hybrid ryegrass	Grass
1.6.1.6	Other ryegrasses	Grass
1.6.2	Fescue	
1.6.2.1	Red Fescue	Grass
1.6.2.2	Sheep's Fescue	Grass
1.6.2.3	Tall Fescue	Grass
1.6.2.4	Other fescues	Grass
1.6.3	Bluegrass	
1.6.3.1	Kentucky bluegrass	Grass
1.6.3.2	Fowl bluegrass	Grass

1.6.3.3	Wood bluegrass	Grass
1.6.3.4	Meadow fescue	Grass
1.6.3.5	Other bluegrasses	Grass
1.6.4	Other grasses	
1.6.4.1	Timothy-grass	Grass
1.6.4.2	Cock's-foot	Grass
1.6.4.3	Colonial bent	Grass
1.6.4.4	Crested dog's-tail	Grass
1.6.4.5	Tufted hair-grass	Grass
1.6.4.6	Junegrass	Grass
1.6.4.7	Other grass seed crops	Grass
1.7	Oil-bearing seeds	
1.7.1	-	
1.7.1.1	Poppy seed	Linseed
1.7.1.2	Caraway	Linseed
1.7.1.3	Linseed	Linseed
1.7.1.4	Mustard seed	Oilseed rape
1.7.1.5	Winter Rapeseed	Oilseed rape
1.7.1.6	Summer Rapeseed	Oilseed rape
1.7.1.7	Evening primrose	Linseed
1.7.1.8	Sunflower	Sunflower
1.7.1.9	Camelina	Linseed
1.7.1.10	Crambe	Linseed
1.7.1.11	Other oil-bearing seeds	Linseed
1.8	Fibre crops	
1.8.1	-	
1.8.1.1	Hemp	Sunflower
1.8.1.2	Flaxseed	Linseed
1.8.1.3	Nettle	Sunflower
1.8.1.4	Other fibre crops	Sunflower
1.9	Green fertiliser crops	
1.9.1	Leguminous green fertilisers	
1.9.1.1	Clover	Linseed
1.9.1.2	Lupin	Linseed
1.9.1.3	Serradella	Linseed
1.9.1.4	Common vetch	Linseed
1.9.1.5	Sanfoin	Linseed
1.9.1.6	Field beans	Beans (field+vegetable)
1.9.1.7	Other leguminous green fertilisers	Beans (field+vegetable)
1.9.2	Grass family green fertilisers	
1.9.2.1	Rye	Grass
1.9.2.2	Ryegrass	Grass
1.9.3	Brassicaceae green fertilisers	Oilseed rape
1.9.3.1	Oil radish	Oilseed rape
1.9.3.2	Rapeseed	Oilseed rape
1.9.3.3	Yellow mustard seed	Oilseed rape
1.9.3.4	Rape kale	Oilseed rape
1.9.3.5	Marrow-stem kale	Oilseed rape
1.9.4	Other green fertilisers	
1.9.4.1	Phacelia	Grass
1.9.4.2	Corn spurrey	Grass
1.9.4.3	Marigold (Tagetes)	Grass
1.9.4.4	Sticky nightshade	Grass

1.9.4.5	Sudan grass	Grass
1.10	Fodder crops	
1.10.1	Leguminous fodder crops	
1.10.1.1	Clover	Linseed
1.10.1.2	Alfalfa	Linseed
1.10.1.3	Common vetch	Linseed
1.10.1.4	Sanfoin	Linseed
1.10.1.5	Field beans (for silaging)	Beans (field+vegetable)
1.10.1.6	Field mustard	Sugar beets
1.10.2	Other fodder crops.	Sugar beets
1.11	Other arable crops	Sugar beets
1.11.1	-	
1.11.1.1	Chicory (roots)	Sugar beets
1.11.1.2	Wild chicory	Sugar beets
1.11.1.3	Buckwheat	Cereals
1.11.1.4	Hops	X
1.11.1.5	Common madder	Sugar beets
1.11.1.6	Elephant grass	Grass
2	Cultivated grassland	
2.1	Fodder grassland	
2.1.1	-	
2.1.1.1	Pastureland	x
2.1.1.2	Mowing grassland	x
2.2	Grass sod	x
3	Fruit crops Only refers to production of unharvested fruits	
3.1	Large fruits	
3.1.1	Pomes	x
3.1.1.1	Apples	x
3.1.1.2	Pears	x
3.1.1.3	Quince	x
3.1.1.4	Medlar	x
3.1.1.5	Other pomes	x
3.1.2	Drupes	
3.1.2.1	Cherries	x
3.1.2.2	Plum	x
3.1.2.3	Apricot	x
3.1.2.4	Peach	x
3.1.2.5	Other drupes	x
3.2	Small fruits	
3.2.1	Strawberries	Strawberries
3.2.2	Berries	
3.2.2.1	Currant (red, white and black)	X
3.2.2.2	Gooseberry	X
3.2.2.3	Blueberry	X
3.2.2.4	Cranberry	Strawberries
3.2.2.5	Mulberry	X
3.2.2.6	Rose hips	X
3.2.2.7	Kiwiberry	X
3.2.2.8	Elderberry, Chokeberry, Sea-buckthorn	X
3.2.2.9	Other berries	X
3.2.3	Grapes	X
3.2.3.1	Table grape	X

3.2.3.2	Wine grape	X
3.2.4	'Blackberry and raspberry family (Rubus spp.)'	X
3.2.4.1	Blackberry	X
3.2.4.2	Raspberry	X
3.2.4.3	Dewberries	X
3.3	Nuts	X
3.3.1	-	-
3.3.1.1	Hazelnut	X
3.3.1.2	Chestnut	X
3.3.1.3	Walnut	X
3.4	Other fruits	X
3.4.1	-	
3.4.1.1	Fig	X
3.4.1.2	Kiwi	X
4	Vegetable crops	
4.1	Leafy vegetables	
4.1.1	Lettuce; <i>Lactuca</i> spp	Beans (field+vegetable)
4.1.2	Endive	Beans (field+vegetable)
4.1.3	Spinach family	
4.1.3.1	Spinach	Beans (field+vegetable)
4.1.3.2	Chard	Sugar beets
4.1.3.3	Orache	Beans (field+vegetable)
4.1.3.4	Purslane	Beans (field+vegetable)
4.1.4	Other leafy vegetables	
4.1.4.1	Chicory	Sugar beets
4.1.4.2	Garden cress	Beans (field+vegetable)
4.1.4.3	Watercress	Beans (field+vegetable)
4.1.4.4	Lamb's lettuce	Beans (field+vegetable)
4.1.4.5	Rocket	Beans (field+vegetable)
4.1.4.6	Sea lavender	Beans (field+vegetable)
4.2	Pulses	
4.2.1	Bean with pod	
4.2.1.1	Bush green beans	Beans (field+vegetable)
4.2.1.2	Bush common bean	Beans (field+vegetable)
4.2.1.3	Waxpod bean	Beans (field+vegetable)
4.2.1.4	Climbing green beans	Beans (field+vegetable)
4.2.1.5	Climbing common bean	Beans (field+vegetable)
4.2.1.6	Snap bean	Beans (field+vegetable)
4.2.1.7	Runner bean	Beans (field+vegetable)
4.2.1.8	Yardlong bean	Beans (field+vegetable)
4.2.2	Podless beans	
4.2.2.1	Broad bean	Beans (field+vegetable)
4.2.2.2	Lima bean	Beans (field+vegetable)
4.2.2.3	Flageolet bean	Beans (field+vegetable)
4.2.3	Pea with pod	
4.2.3.1	Legume/pod	Peas
4.2.3.2	Asparagus pea	Peas
4.2.3.3	Sugar snap	Peas
4.2.4	Pea without pod	
4.2.4.1	Green pea/garden pea	Peas
4.2.4.2	Marrowfat pea	Peas
4.2.5	Vegetable sprouts	
4.2.5.1	Bean sprouts	x

4.2.5.2	Alfalfa	x
4.2.5.3	Other vegetable sprouts	x
4.3	Fruiting vegetables	-
4.3.1	Fruiting vegetables of <i>Cucurbitaceae</i> with, edible skin	-
4.3.1.1	Gherkin	potatoes
4.3.1.2	Courgette	potatoes
4.3.1.3	Cucumbers	x
4.3.2	Fruiting vegetables of <i>Cucurbitaceae</i> with, non-edible skin	-
4.3.2.1	Pumpkin family	potatoes
4.3.2.2	Melon	x
4.3.2.3	Watermelon	x
4.3.3	Fruiting vegetables of <i>Solanaceae</i>	
4.3.3.1	Aubergines	x
4.3.3.2	Tomato	x
4.3.3.3	Sweet pepper	x
4.3.4	Fruiting vegetables of <i>Malvaceae</i>	
4.3.4.1	Okra	x
4.4	Cabbages	
4.4.1	Heading cabbages	
4.4.1.1	Heading cabbage	Cabbage
4.4.1.2	Sprouts	Cabbage
4.4.2	Cauliflower family	
4.4.2.1	Cauliflower	Cabbage
4.4.2.2	Broccoli	Cabbage
4.4.3	Loose leaf cabbage family	
4.4.3.1	Chinese cabbage	Cabbage
4.4.3.2	Kale	Cabbage
4.4.4	Stalk cabbage	
4.4.4.1	Kohlrabi	Cabbage
4.5	Root vegetables and tubers	
4.5.1	Radish family	
4.5.1.1	Cultivated radish	Sugar beets
4.5.1.2	Black/white radish	Sugar beets
4.5.2	Root vegetables (<i>Umbelliferae</i>)	
4.5.2.1	Carrots	Carrots
4.5.2.2	Skirret	Carrots
4.5.2.3	Hamburg root parsley	Carrots
4.5.2.4	Parsnips	Carrots
4.5.3	Other root vegetables and tubers	
4.5.3.1	Turnip	Sugar beets
4.5.3.2	Swede	Sugar beets
4.5.3.3	Jerusalem artichoke	Sugar beets
4.5.3.4	Chinese artichoke	Sugar beets
4.5.3.5	Sweet potato	Sugar beets
4.5.3.6	Beetroot	Sugar beets
4.5.3.7	Celeriac	Sugar beets
4.5.3.8	Salsify	Sugar beets
4.5.3.9	Horseradish	Sugar beets
4.5.3.10	Yam	Sugar beets
4.6	Onion family	
4.6.1.	Onions	

4.6.1.1	Seed onions	Onions
4.6.1.2	First year bulb onion	Onions
4.6.1.3	Second year bulb onion	Onions
4.6.1.4	Silverskin	Onions
4.6.1.5	Picklers	Onions
4.6.2	Shallots	
4.6.2.1	Seed shallot	Onions
4.6.2.2	Bulb shallot	Onions
4.6.3.1	Scallion	Onions
4.6.4	Garlic	Onions
4.7	Stalk vegetables	
4.7.1	-	
4.7.1.1	Asparagus	Beans (field+vegetable)
4.7.1.2	Stalk celery	Beans (field+vegetable)
4.7.1.3	Cardoon	Beans (field+vegetable)
4.7.1.4	Rhubarb	Beans (field+vegetable)
4.7.1.5	Florence fennel	Sugar beets
4.7.1.6	Leek	Beans (field+vegetable)
4.7.1.7	Artichoke	Beans (field+vegetable)
4.7.1.8	Sea kale	Beans (field+vegetable)
4.8	Other vegetable crops	
4.8.1	-	
4.8.1.1	Sweet corn	Maize
5	Herb crops (fresh and dried herbs) Herb crops (fresh and dried herbs)	Beans (field+vegetable)
5.1	Aromatic herbs	
5.1.1	-	
5.1.1.1	Basil	Beans (field+vegetable)
5.1.1.2	Chives	Beans (field+vegetable)
5.1.1.3	Savoury	Beans (field+vegetable)
5.1.1.4	Lemon balm	Beans (field+vegetable)
5.1.1.5	Dill	Beans (field+vegetable)
5.1.1.6	Tarragon	Beans (field+vegetable)
5.1.1.7	Hyssop	Beans (field+vegetable)
5.1.1.8	Chervil	Beans (field+vegetable)
5.1.1.9	Coriander	Beans (field+vegetable)
5.1.1.10	Parsley	Beans (field+vegetable)
5.1.1.11	Lovage	Beans (field+vegetable)
5.1.1.12	Marjoram	Beans (field+vegetable)
5.1.1.13	Oregano	Beans (field+vegetable)
5.1.1.14	Mint	Beans (field+vegetable)
5.1.1.15	Burnet	Beans (field+vegetable)
5.1.1.16	Rosemary	Beans (field+vegetable)
5.1.1.17	Sage	Beans (field+vegetable)
5.1.1.18	Thyme	Beans (field+vegetable)
5.1.1.19	Fennel	Beans (field+vegetable)
5.1.1.20	Leaf Celery	Beans (field+vegetable)
5.1.1.21	Sorrel	Beans (field+vegetable)
5.1.1.22	Other aromatic garden herbs	Beans (field+vegetable)
5.2	Aromatic root crops	

5.2.1	-	
5.2.1.1	Lovage root	Beans (field+vegetable)
5.2.1.2	Angelica	Beans (field+vegetable)
5.2.1.3	Burnet Saxifrage root	Beans (field+vegetable)
5.2.1.4	Hamburg root parsley	Beans (field+vegetable)
5.2.1.5	Other aromatic root crops	Beans (field+vegetable)
5.3	Medicinal herbs	
5.3.1	-	
5.3.1.1	Indian tobacco	Beans (field+vegetable)
5.3.1.2	Woolly foxglove	Beans (field+vegetable)
5.3.1.3	Heartsease	Beans (field+vegetable)
5.3.1.4	German chamomile	Beans (field+vegetable)
5.3.1.5	Purple coneflower	Beans (field+vegetable)
5.3.1.6	Pot marigold	Beans (field+vegetable)
5.3.1.7	Other medicinal herbs	Beans (field+vegetable)
5.4	Medicinal root crops	
5.4.1	-	
5.4.1.1	Valerian	Beans (field+vegetable)
5.4.1.2	Ginseng	Beans (field+vegetable)
5.4.1.3	Purple coneflower root	Beans (field+vegetable)
5.4.1.4	Other medicinal root crops	Beans (field+vegetable)
5.5	Seed herbs	
5.5.1	-	
5.5.1.1	Caraway	Oilseed rape
5.5.1.2	Poppy seed	Oilseed rape
5.5.1.3	Other seed herbs	Oilseed rape
6	Mushroom crops	
6.1	Edible mushrooms	
6.1.1	-	
6.1.1.1	Champignon mushroom	x
6.1.1.2	Oyster mushroom	x
6.1.1.3	Other mushrooms	x
7	Ornamental crops	
7.1	Flower bulb and Flower corm crops	
7.1.1	-	
7.1.1.1	Winter Flower bulbs and Flower corms cultivation for reproduction	Onions
7.1.1.2	Summer Flower bulbs and Flower corms cultivation for reproduction	Onions
7.1.1.3	Winter Bulb flower and Corm flower forced cultivation	Onions
7.1.1.4	Summer Bulb flower and Corm flower forced cultivation	Onions
7.2	Floriculture crops	
7.2.1	-	
7.2.1.1	Pot plants	Beans (field+vegetable)
7.2.1.2	Cut flowers	Beans (field+vegetable)
7.2.1.3	Forced shrubs	Beans (field+vegetable)
7.2.1.4	Cut green	Beans (field+vegetable)

7.3	Tree nursery crops	
7.3.1	-	
7.3.1.1	Spindle trees	x
7.3.1.2	Transplanted trees	x
7.3.1.3	High Avenue trees	x
7.3.1.4	Climbing plants	Cabbage
7.3.1.5	Roses	Cabbage
7.3.1.6	Conifers	Cabbage
7.3.1.7	Ornamental shrubs	Cabbage
7.3.1.8	Christmas trees	Cabbage
7.3.1.9	Heather	Cabbage
7.3.1.10	Forest trees and hedging plants	Cabbage
7.3.1.11	Fruit trees and shrubs	Cabbage
7.4	Perennial crops	Potatoes
7.5	Flower seed crops	Potatoes
7.6	Marsh and Water plants	x
7.7	Plant breeding crops and basic seed production for arable, vegetable and fruit crops, herbs and ornamental crops.	x
8	Public green spaces	
8.1	Grass vegetation	
8.1.1	-	
8.1.1.1	Lawn (including grass sods)	x
8.1.1.2	Playing field (including grass sods)	x
8.1.1.3	Sports field including golf courses and grass sods	x
8.1.1.4	Grassy verges	x
8.2	Woody plantings	
8.2.1	-	
8.2.1.1	Avenue and border trees	x
8.2.1.2	Shelter belts, windbreaks and protective hedgerows	x
8.2.1.3	Other woody plantings (forest trees and verge plantings)	x
8.2.1.4	Grassy verges	x
8.3	Herbaceous plantings	x
9	Forestry	
9.1	Deciduous trees	x
9.2	Coniferous trees	x
10	Uncultivated land	
10.1	Temporarily uncultivated terrain	
10.1.1	-	
10.1.1.1	Deforestation area	x
10.1.1.2	Temporarily uncultivated land	x
10.1.1.3	Buffer areas of fields	x
10.2	Permanently uncultivated land	
10.2.1	-	
10.2.1.1	Closed surfaces	x
10.2.1.2	Half-open surfaces	x
10.2.1.3	Open surfaces	x

10.2.1.4	Unmetalled	x
11	Water courses	
11.1	Bank (dry or otherwise)	x
11.2	Dry ditches	x
11.3	Water courses carrying water	x
11.4	Maintenance paths for water courses	x
11.5	Ponds	x
12	Reed and osier crops	
12.1	-	
12.1.1	-	
12.1.1.1	Osier	x
12.1.1.2	Reed	x
13	Refuse heaps	x
14	In and around the house, private home environment	
14.1	Ornamental garden	x
14.2	Vegetable gardens	x
14.3	House plants and container plants	x
14.4	Container plants	x
14.5	Lawns and pastures	x
14.6	Pastures	x
14.7	Open surfaces	x
14.8	Half-open surfaces	x
14.9	Closed surfaces	x
14.10	Unmetalled terrain	x
15	Disinfectants	
15.1	-	
15.1.1	-	
15.1.1.1	Agricultural and horticultural equipment, tools and materials	x
x	not relevant for downward directed spraying	

4. REFERENCES

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- 9 Jan van de Zande & Mechteld ter Horst, in prep., PRI report 420, Wageningen, The Netherlands