



The implementation of the dose expression per hectare Leaf Wall Area in vertical crops in Belgium

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18-20 October 2016, Vienna

History of the /ha LWA expression in Belgium

1996 first attempts to express the dose per ha LWA,

- For the authorizations of new active substances
- in top fruit.

long-lasting official stewardship

- The growers are now well informed and apply the dose /ha LWA applied in practice.
- The growers still recalculate the dose in L/ha soil

Problem: the controls of the Federal Food Agency based on the total cadastral area of the field





2007 Implementation of the LWA
In glasshouse fruiting vegetables, small fruit,
grapevine

Study to determine

- Cropping systems (single, double rows,...)
- the dimensions of the crops,
- the sprayed height,
- the pests and diseases
- application technique
- spray volume
- most appropriate dose expression for trials < > dose for the grower

The growers do not apply the dose per LWA ha yet in
everyday practice
recalculation by the stewardship service

It is urgent to implement an harmonized dose expression...

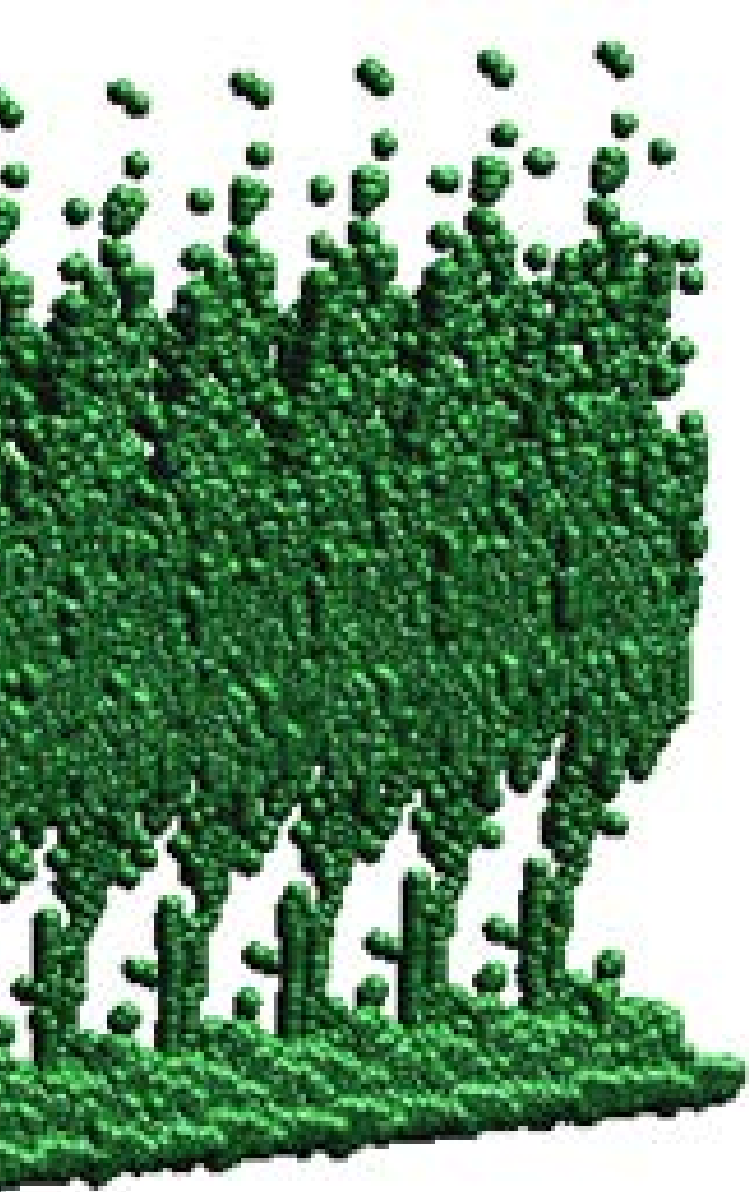
“After a decade of debate there is little progress towards agreeing a single method of dose expression for pesticides used for tree fruit spraying in Europe” (Walklate, Cross, 2009)

PPP use restrictions

It is impossible to

- Reduce pesticide residues on food commodities
- Reduce environmental risk
- Reduce operator, bystander contamination
- Reduce operational costs by more efficient use of pesticides

If the minimum effective dose is not exactly defined in the authorization process



A lot of research to improve the spraying techniques (precision agriculture, LIDAR, crop sensors)

air flow pattern
tree architecture
total leaf cover,
leaf wall porosity
tree volume

An urgent need of harmonization of the PPP evaluation at EU level

It is impossible to harmonize the evaluations if several dose expressions are used in the trials and in the dossiers

Tableau 3 : Dose par hectare cadastral de dix-sept spécialités fongicides utilisées en vigne.

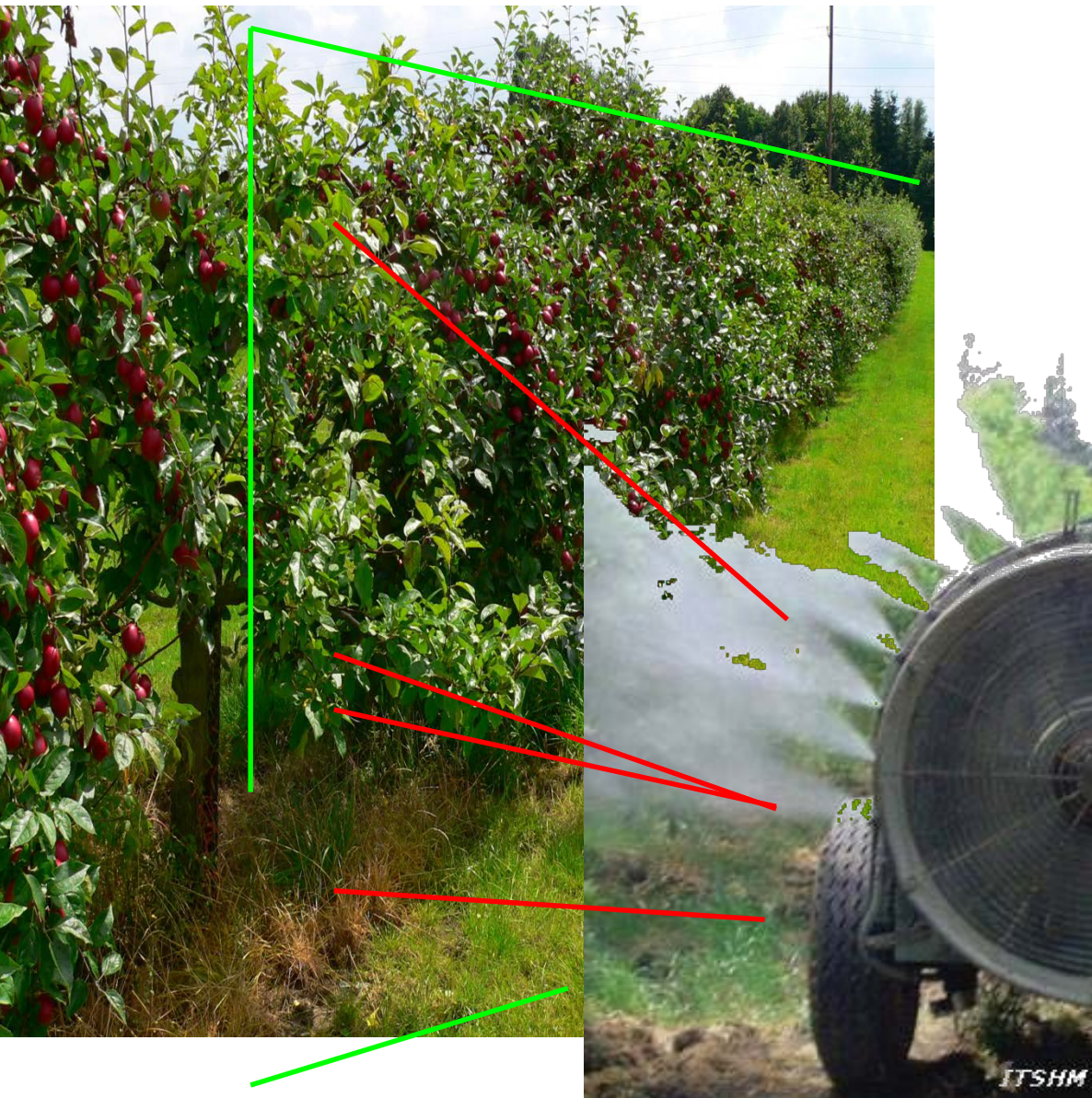
| | | France | Allemagne | | | | Espagne | | Italie | | Suisse | | | | |
|---------|------------|---------|-----------|------|------|-------|---------|------|--------|------|--------|------|-------|------|------|
| Action | Spécialité | Dose/ha | 1 | 2 | 3 | 4 | Mini | Maxi | Mini | Maxi | 1 | 2 | 3 | 4 | 5 |
| Oïdium | P1 | 0,125 | 0,06 | 0,12 | 0,18 | 0,24 | 0,13 | 0,15 | 0,125 | 0,15 | 0,09 | 0,12 | 0,15 | 0,18 | 0,24 |
| Oïdium | P2 | 0,2 | 0,08 | 0,16 | 0,24 | 0,32 | 0,2 | 0,3 | 0,2 | 0,3 | | 0,16 | 0,2 | 0,24 | 0,32 |
| Oïdium | P3 | 12,5 | 3,6 | 4,8 | 2,4 | 3,2 | 2,5 | 7,5 | 2,0 | 12,0 | 1,8 | 3,2 | 4,0 | 4,8 | 6,4 |
| Oïdium | P4 | 2,0 | 0,8 | 1,6 | 2,4 | 3,2 | 2,0 | 2,0 | | | 1,2 | 1,6 | 2,0 | 2,4 | 3,2 |
| Oïdium | P5 | 0,12 | | | | | | | 0,15 | 0,2 | 0,075 | 0,1 | 0,125 | 0,15 | 0,2 |
| Oïdium | P6 | 0,2 | 0,06 | 0,12 | 0,18 | 0,24 | | | | 0,2 | 0,09 | 0,12 | 0,15 | 0,18 | 0,24 |
| Oïdium | P7 | 12,5 | 3,6 | 4,8 | 2,4 | 3,2 | 2,5 | 7,5 | 2,0 | 12,0 | 2,4 | 3,2 | 4,0 | 4,8 | 6,4 |
| Oïdium | P8 | 0,25 | 0,06 | 0,12 | 0,18 | 0,24 | | | 0,15 | 0,3 | 0,3 | 0,2 | 0,25 | 0,3 | 0,4 |
| Oïdium | P9 | 0,25 | 0,1 | 0,2 | 0,3 | 0,375 | | | 0,2 | 0,25 | | 0,2 | 0,25 | 0,3 | 0,4 |
| Oïdium | P10 | 0,2 | 0,08 | 0,16 | 0,24 | 0,32 | 0,1 | 0,2 | 0,2 | 0,25 | | 0,16 | 0,2 | 0,24 | 0,32 |
| Mildiou | P11 | 1,5 | 0,48 | 0,96 | 1,44 | 1,92 | | | | | | | | | |
| Mildiou | P12 | 1,9 | 0,4 | 0,8 | 1,2 | 1,6 | | 1,8 | | | | 1,0 | 1,25 | 1,5 | 2,0 |
| Mildiou | P13 | 3,5 | | | | | 1,50 | 2,00 | | | 1,8 | | | | |
| Mildiou | P14 | 4,0 | | | | | | | 3,0 | 4,0 | | 1,6 | 2,0 | 2,4 | 3,2 |
| Mildiou | P15 | 2,0 | 0,48 | 0,96 | 1,44 | 1,92 | 1,35 | 1,60 | 1,8 | 2,0 | | 1,0 | 1,25 | 1,5 | 2,0 |
| Mildiou | P16 | 2,0 | 0,5 | 1,0 | 1,5 | 2,0 | | | 1,6 | 2,0 | | 1,6 | 2,0 | 2,4 | 3,2 |
| Mildiou | P17 | 1,3 | 0,6 | 1,2 | 1,8 | 2,4 | | | | | | 1,2 | 1,5 | 1,8 | 2,4 |

Doses de produits de protection de la vigne dans 5 pays européens et les besoins d'une harmonisation (Codis et al ,2013)

Dose in ha LWA is a first step to the harmonization

This dose expression reflects how the treatment is actually done :

Spray of a vertical crop – dose / hectare vertical surface

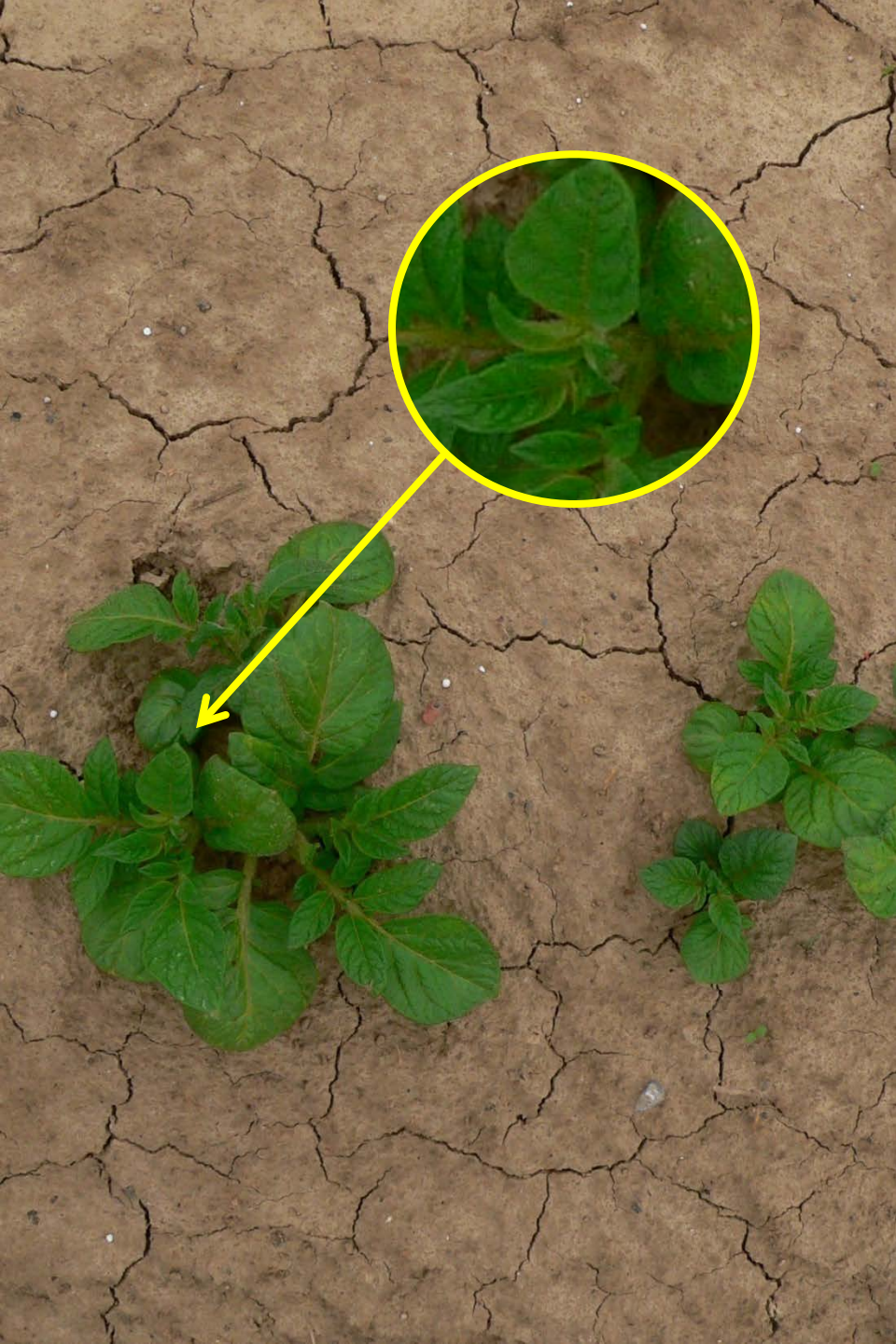




Dose /ha LWA is not contradictory with tree row volume, Leaf Area Index

Dose /ha LWA is not contradictory with dose adjustments that are related to BBCH stages





Proposed solutions

Improve the content of efficacy study reports

“Reproducibility is the ability of an entire experiment or study to be duplicated, either by the same researcher or by someone else working independently.”
(Wikipedia)

“All parameters owing to calculate the dose/LWA must be included in trials reports” (EPPO PP 1/239 -september 2005)

These expressions should be avoided in the efficacy reports:

~~“standard orchard dimensions”~~

~~“given concentration for a theoretical spray volume”~~

~~“application to run-off”~~

« Equipment and crop parameters » for all types of laterally treated crops



| | Needed today | Needed tomorrow |
|----------------------------------|--|---|
| Application | Actual treated height | |
| | Actual treated length | |
| | Actual spray volume | |
| | Actual spray concentration | |
| | Nb of treated rows, nb of treated sides | |
| | + conversion in kg/ha LWA | |
| Spray quality | Nozzle type | |
| | Pressure | |
| | Description of the vertical boom (nb of nozzles, spacing of the nozzles) | |
| | | Spray of the entire canopy (or not) = spray band, treated height of the canopy |
| | | Airflow profiles |
| | | Speed of travel of sprayer |
| | | Type of sprayer |
| | | Relevance of the sprayer used in the trial (to the practical conditions of use) |
| | | Quality of the spray covering |
| | | Uniformity of the spray covering |
| Habitus of the crop | BBCH Crop growth stage | |
| | | Crop porosity, leaf canopy density |
| | | Foliar volume |
| | | Positioning of the disease/pest observations |
| | | Leaf Area Index |
| | | Maximum height of the plants, height and mid width of the crown |
| Crop density in the field | Distance between rows | |
| | Distance between plants in the row | |
| | | Pruning or training system |
| | | Arrangement in rows (single, double), or as single plants |



How to express the dose for vertical crops in the efficacy dossier?

Doses in the efficacy trial reports, BAD, dRR should be expressed /ha LWA considering the dimensions of the crop in *each individual trial*

Assuming:

N: number of plants in the field

D: distance between 2 plants within the row (in m)

E: distance between 2 parallel rows (in m)

H: treated height of the plants (in m)

2 (for the 2 sides of the hedge)

The ratio ha Leaf Wall Area / ha Soil = $(2 \times H)/E$.

The Leaf Wall Area (in m²) in a particular field can also be calculated by

$$\text{LWA (in m}^2\text{)} = 2 \times N \times D \times H$$

Establish standard scenarios for applications on different crop structures (fate, ecotox, tox)?

Standard exposure scenarios for the risk assessments:

- soil top layer, surface waters, ground water, air
- consumers, operators, workers, bystanders
- small mammals, birds, aquatic organisms, bees, other arthropods, earthworms,...

Standard scenarios should be developed to describe the **applications** on different **crop structures**:

- Arbitrary, simplification of the reality
- Realistic worst cases (covering a majority of situations)
- Not too many different scenarios
- Relevance of the expression in ha soil?

| Crop | distance between rows (in m) | treated height of the plants (in m) | ha Leaf Wall Area / ha ground surface |
|--|---------------------------------|--|--|
| apple, pear | 3.5 | 3 | 1.7 |
| cherry, plum, peach | 3.5 | 3 | 1.7 |
| Grape | 2.2 | 2 | 1.8 |
| Hop | 2.8 | 5 | 3.6 |
| raspberry, red, black, white currants, gooseberry, blackberry, blueberry, kiwiberry (outdoor and under protection) | 2 | 2 | 2.0 |
| peppers (under protection) | 1.6 | 2 | 2.5 |
| tomato (under protection) | 1.6 | 2 | 2.5 |
| Aubergine (under protection) | 1.6 | 2 | 2.5 |
| cucumber (under protection) | 1.6 | 2 | 2.5 |
| gherkin (under protection) | 1.6 | 1.5 | 1.9 |
| courgette (under protection) | 1.6 | 1.5 | 1.9 |
| Melon (under protection) | 1.6 | 2 | 2.5 |
| climbing bean (under protection) | 1.6 | 2 | 2.5 |

Determination of the GAP (dose /ha LWA) by the efficacy expert is the basis for the evaluations of other sections (FATE/ECOTOX/ TOX)

- Start from the dose /ha LWA set by the efficacy expert
- Recalculate from /ha LWA to /ha ground surface using the *standard Belgian conversion factors* considering the standard dimensions for Belgian orchards/glasshouses

Mutual recognition

Translation of the dose /ha ground surface granted in another country to /ha LWA

- Considering the dimensions of the crop in *each individual trial*
- If not available, considering the *standard dimensions in the country of origin* (**NOT** considering the standard dimensions in Belgium)

RESIDUES evaluation

Start from the dose /ha LWA set by the efficacy expert

If necessary, recalculate the doses in the residue trials (/ha ground surface) to /ha LWA

3 possibilities:

1 - Residue trials expressed /ha LWA: no calculation needed

2 - Residue trials expressed /ha ground surface but dimensions of the crop available : recalculate considering the dimensions of the crop in *each individual trial*

(3 - Residue trials expressed /ha ground surface but NO dimensions of the crop available: recalculate using the *standard conversion factors for EU residue trials* (NOT considering the standard dimensions in Belgium))

Standard conversion factors for EU residue trials (not agreed)

| Crop | ha Leaf Wall Area / ha ground surface |
|--|---------------------------------------|
| apple, pear | 1,5 |
| cherry, plum, peach | 1.5 |
| Grape | 1.5 |
| Hop | 4 |
| raspberry, red, black, white currants, gooseberry, blackberry, blueberry, kiwiberry (outdoor and under protection) | 1,5 |
| peppers (under protection) | 2.5 |
| tomato (under protection) | 2.5 |
| Aubergine (under protection) | 2.5 |
| cucumber (under protection) | 2.5 |
| gherkin (under protection) | 2,5 |
| courgette (under protection) | 2,5 |
| Melon (under protection) | 2.5 |
| climbing bean (under protection) | 2.5 |



How do we deal with existing studies and risk assessments?

How should old products be handled in case of re-registration using historical data with incomplete crop measurements data. Not all relevant crop parameters were consistently captured in the past. How can we therefore transform dose rates from currently existing dose expression units to LWA ? (ECPA, 2012)

It is necessary to guess what are the real conditions of use (theoretical standard conditions),

Data from a few trials with more or less complete crop measurements can be used to reconstruct the dose expression in ha LWA



How can we prepare the future ?

MS Regulators – EPPO : Establish a listing of “equipment and crop” parameters that must be reported in trials with vertical crops

GEP organisations: Note all the “equipment and crop” parameters in the efficacy trial reports

Applicants: Present a concise table of the “equipment and crop” parameters for each trial in the BAD.



How can we prepare the future ?

MS « efficacy/environment/tox » regulators :
Establish **Standard EU scenarios** for applications on different crop structures . The MS must compile the standard dimensions of their crops; define realistic worst cases.

MS “residue” regulators, EU Commission, EFSA:

- Request all the “equipment and crop” parameters in the residue trial reports
- Express the MRL for a rate in L/ha **treated plant surface (horizontal or vertical)**