Universitat Politècnica de Catalunya, Barcelona
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Harmonization of dose expression is the key to dose adjustment

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PPP label

Dose

Dose

COMMISSION REGULATION 547/2011
labelling requirements for plant protection products

ANNEX I

Maximum dose per hectare per application

shall be included on the packaging of plant protection products:

Field crops *vs* 3D crops

What is the target ?

Field crops:

ground area = treated crop area

kg/ha ground = kg/ha treated crop area

Orchards / vineyards / plantations:

ground area ≠ treated plant area

kg/ha ground ≠ kg/ha treated crop area

Field crops *vs* 3D crops

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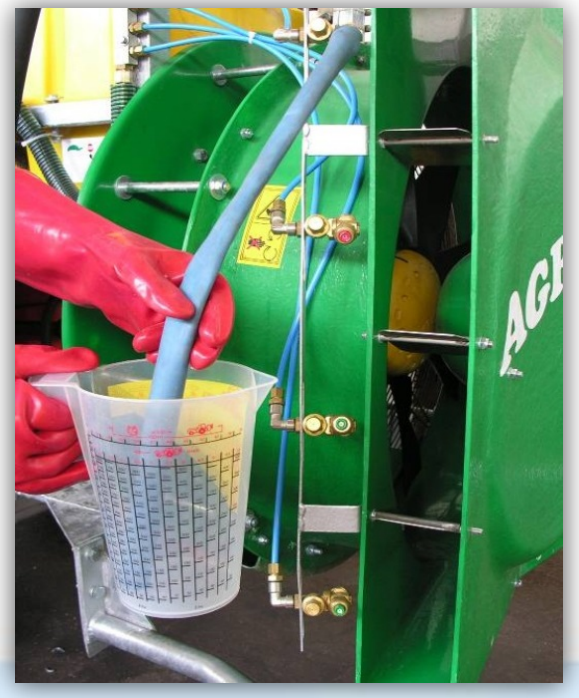
Orchards / vineyards / plantations:

ground area ≠ treated plant area

kg/ha ground ≠ kg/ha treated crop area

Calibration formula

$$\text{Spray volume} = \frac{\text{nozzle flow rate} * \text{numer of nozzles} * 600}{\text{working width} * \text{travel velocity}}$$

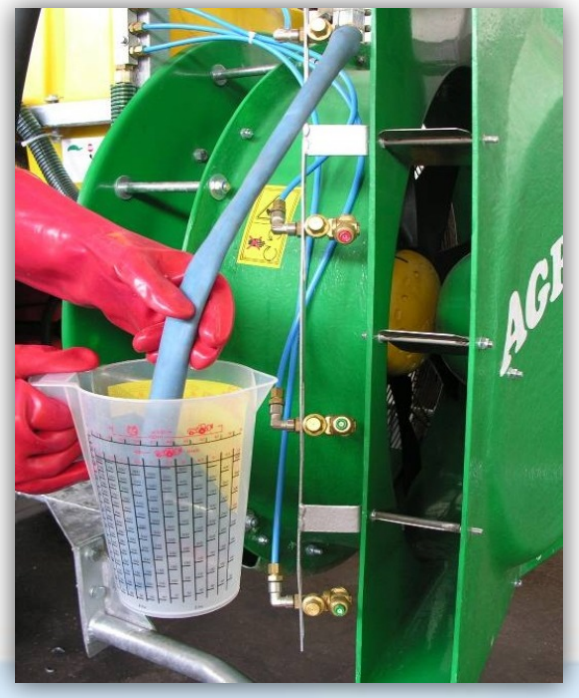


Calibration formula

$$\text{Spray volume} = \frac{\text{nozzle flow rate} * \textbf{numer of nozzles} * 600}{\textbf{working width} * \text{travel velocity}}$$

treated canopy height

row spacing



Calibration formula

treated canopy height

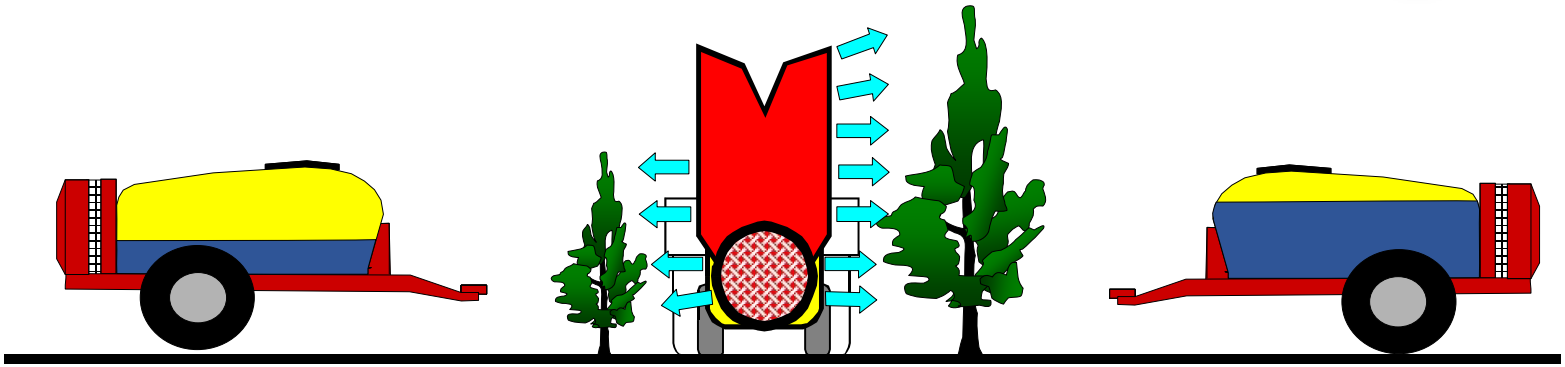
$$\text{Spray volume} = \frac{\text{nozzle flow rate} * \textbf{numer of nozzles} * 600}{\textbf{working width} * \text{travel velocity}}$$

row spacing

Constant spray liquid deposit

Spray volume $_{\text{LOW TREES}}$ < Spray volume $_{\text{HIGH TREES}}$

Spray volume $_{\text{WIDE SPACING}}$ < Spray volume $_{\text{NERROW SPACING}}$

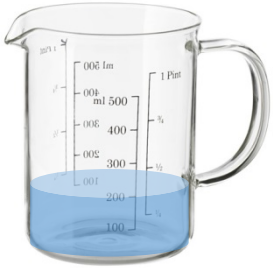


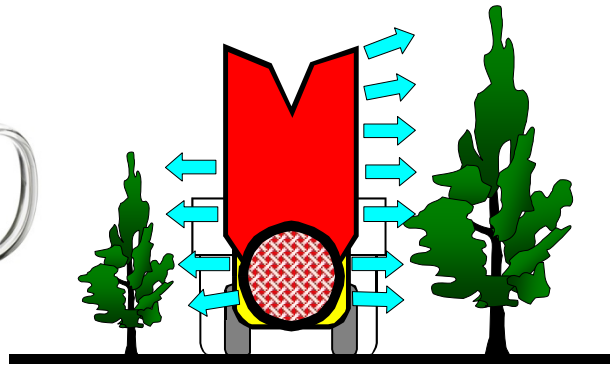
Dose recommendation

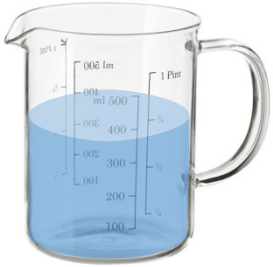
Constant PPP initial deposit

PPP dose/ha ground $_{\text{LOW TREES}}$ < PPP dose/ha ground $_{\text{HIGH TREES}}$

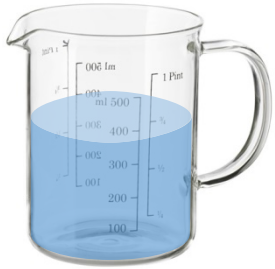
PPP dose dose/ha ground $_{\text{WIDE SPACING}}$ < PPP dose dose/ha ground $_{\text{NERROW SPACING}}$







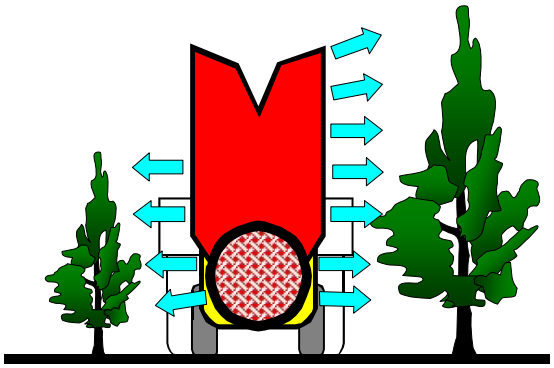
Dose recommendation



Constant dose/ha ground

PPP initial deposit $_{\text{LOW TREES}}$ > PPP initial deposit $_{\text{HIGH TREES}}$

PPP initial deposit $_{\text{WIDE SPACING}}$ > PPP initial deposit $_{\text{NERROW SPACING}}$



Dose expression

Reference units in the EU:

• ground area	[kg/ha]	DK, FI, SE, LT, CZ, HU, PL, SI, SK, UK,FR
• spray volume	[concentration %]	ES, GR, HR, IT, PT, DK, FI, LT, NL
• canopy height - CH	[kg/ha/m_{CH}]	DE, AT, (PL, SI, SE)
• leaf wall area - LWA	[kg/10000 m^2_{LWA}]	BE, (LT, PL,SI, AT)
• tree row volume - TRV	[kg/10000 m^3_{TRV}]	CH
• plant row	[kg/100 m_{row}]	NO

Regulation (EC) 1107/2009 => PPP registration issues:

- zonal efficacy evaluation (collective evaluation of trials within the EPPO zones)
- mutual recognition of PPP authorizations
- labeling (with dose expression as used in the RR and max dose [kg-L/ha]) at national level

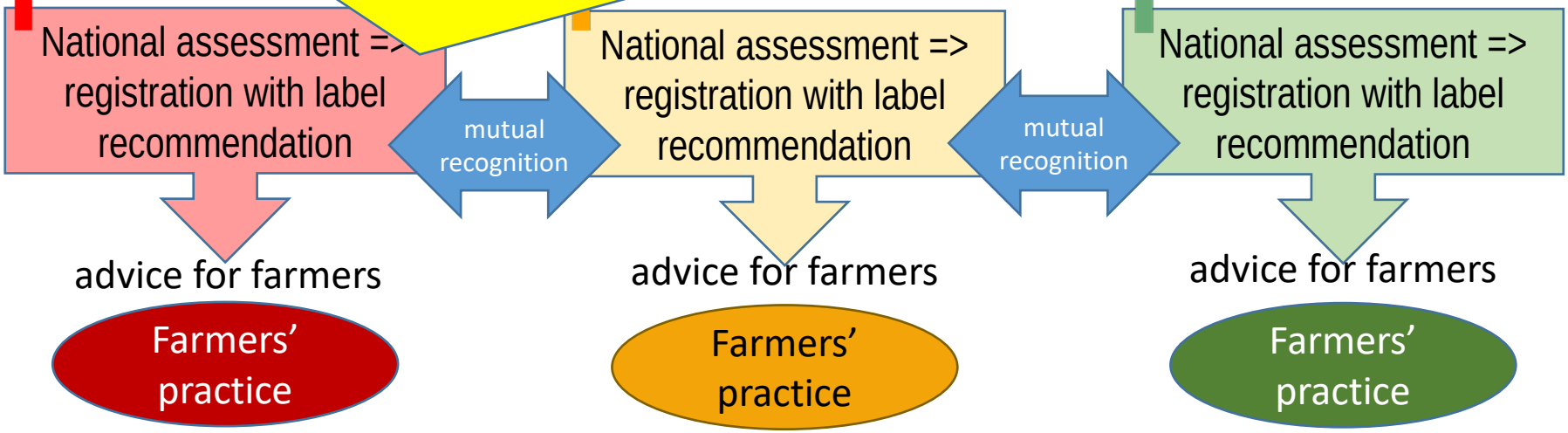
need for HARMONIZATION

CZSC: As of 1 January 2018, efficacy trials in the Central Zone for pome fruit, grapes, and high-growing vegetables must use LWA as the efficacy unit of dose expression.

CZSC: From 1 January 2020, application dossiers for new products and new uses for these crops will only be accepted when the trials use LWA as the unit of dose expression.

Zonal efficacy evaluation (BAD / dRR) => RR & Final Conclusion

CZSC: The conclusion does not affect national dose expression terms on product labels, and the **rate per unit of ground area must still be given** as this is required for risk assessments in other specialist areas.

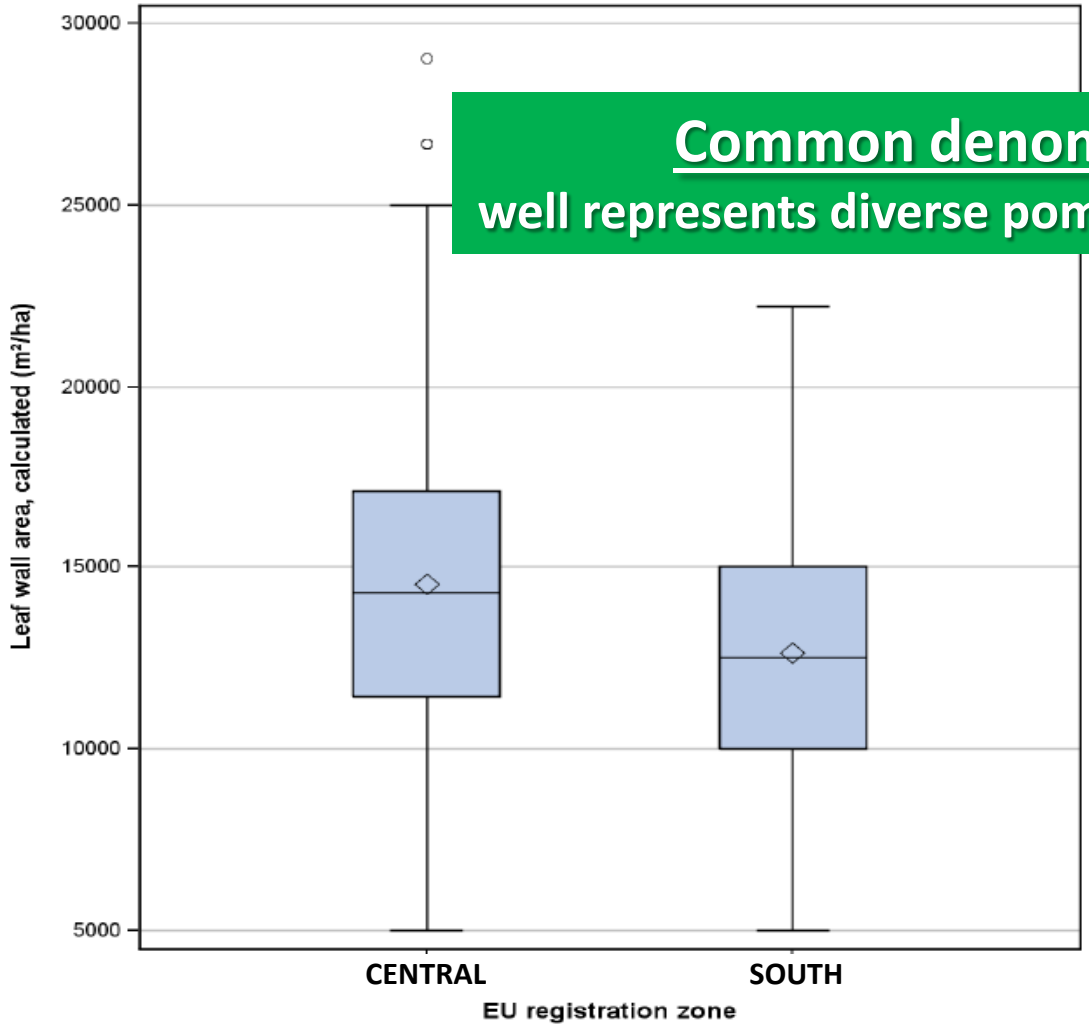


national legislation * local practice * growers' awareness and preferences

Why LWA ?

Industry data (WOHLHAUSER, R., 2012 after Bayer CropScience AG)

Apple + pear: distribution of LWA in the EU registration zones



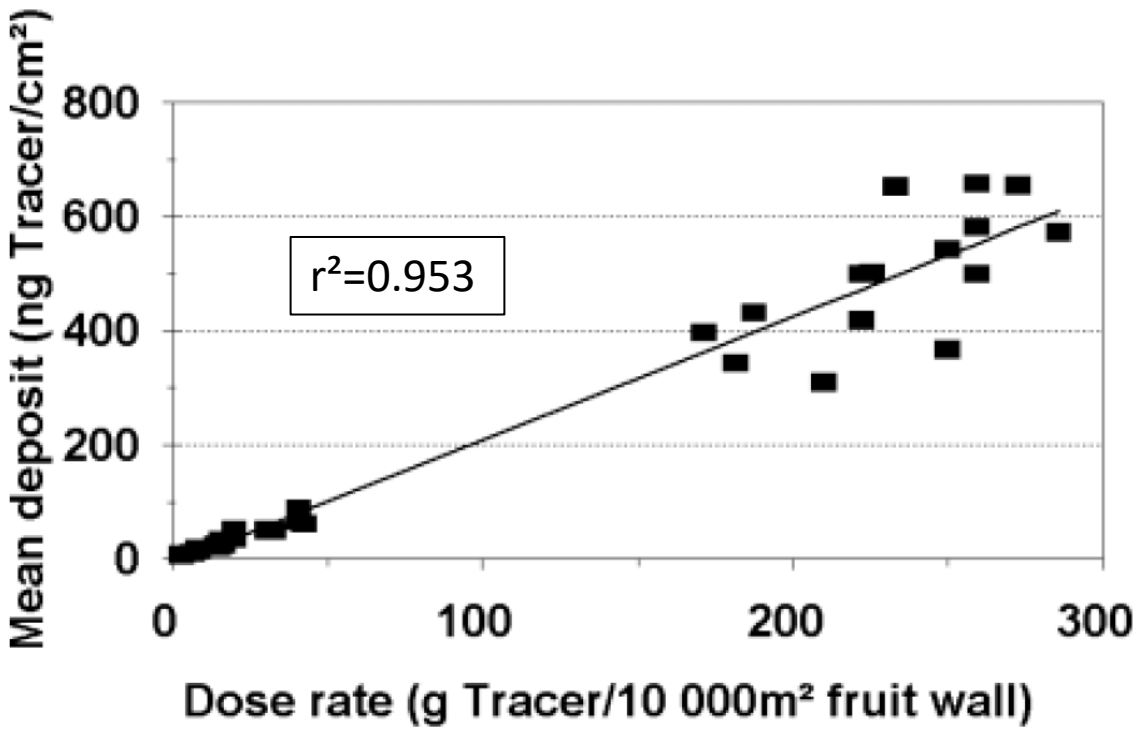
Common denominator

well represents diverse pome fruit structures

Why LWA ?

(KOCH, H. and WEISSER, P., 1995)

Mean initial deposits obtained in 31 trials in apple orchards



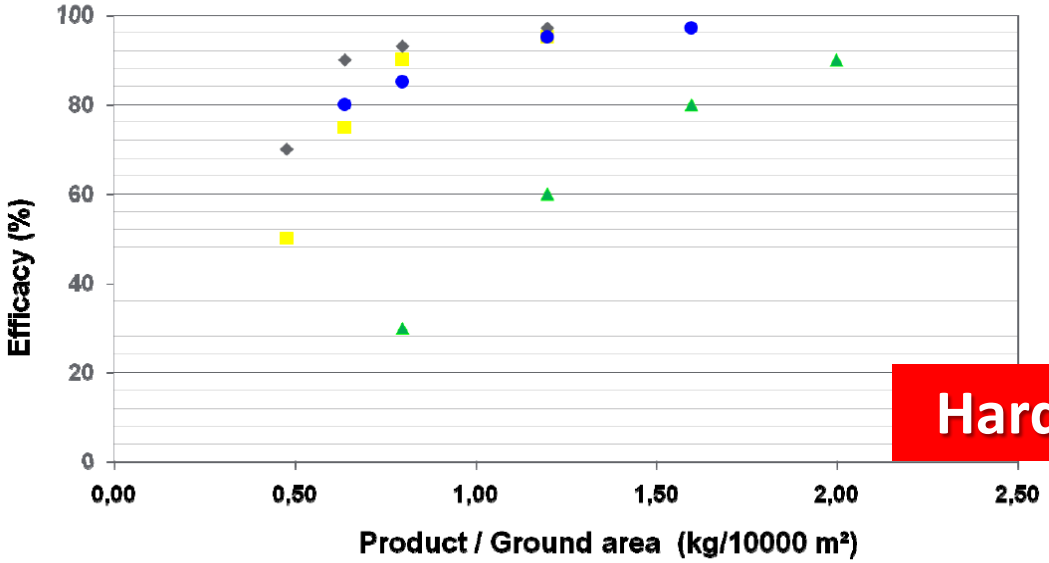
Strong positive linear correlation

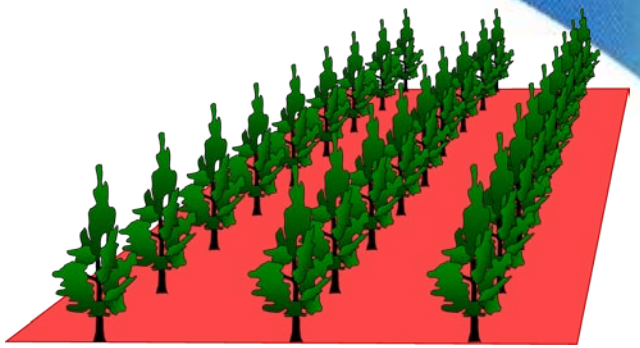
between dose per unit area and deposit on targets in orchards

Dose expression

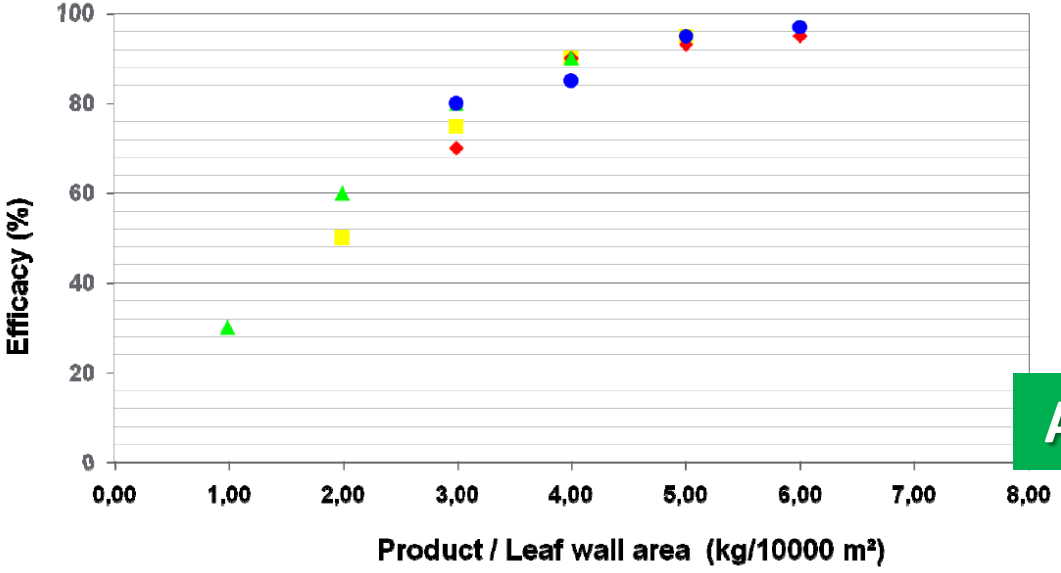
Why LWA ?

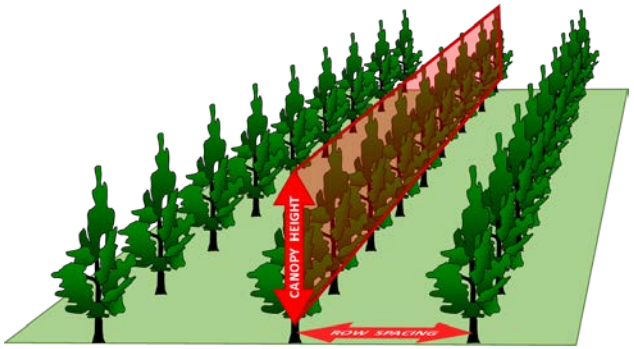
Industry data (WOHLHAUSER, R., 2012





Hard to set accurate dose

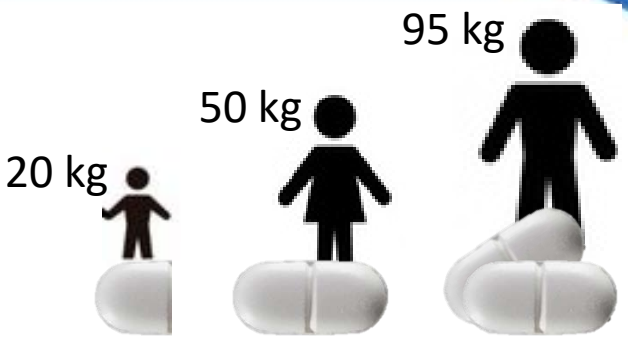




Accurate MED setting

Dose expression

Why LWA ?



- logical and commonly accepted rule:
  dose related to the target
- good representation of diverse crop structures
- good correlation with deposit
- accurate determination of MED.
- easy comparision of efficacy data from individual trials
- simple and intuitive – fair chance to be accepted by applicators
- the first step to direct, systemwise dose adjustment

Why LWA ?

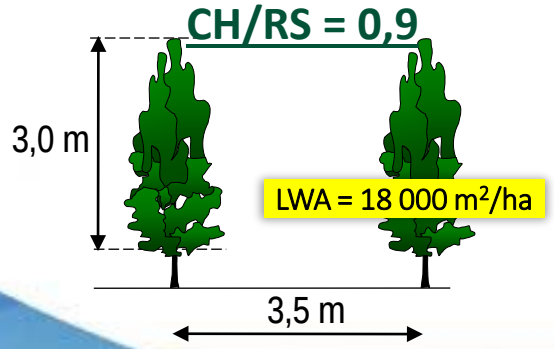
max dose/ha ground on PPP label = dose / 18 000 m² LWA (r.w.c.)

Distribution of LWA by crops – all zones

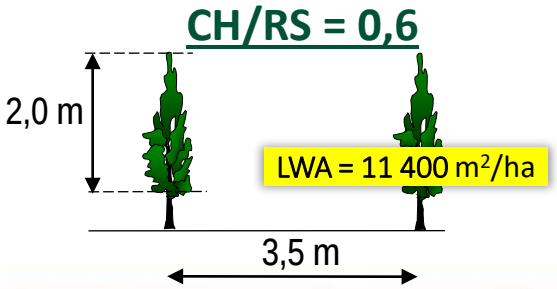
Industry data (WOHLHAUSER, R., 2012 after Bayer CropScience AG)

Analysis Variable : LWA_calc Leaf wall area, calculated (m²/ha									
Crop name	N Obs	Mean	Lower 95% CL for Mean	Upper 95% CL for Mean	25th Pctl	50th Pctl	75th Pctl	90th Pctl	95th Pctl
Apple	900	13462	13226	13697	11000	13143	15000	18462	20000
Pear	321	13465	13023	13908	10476	13333	15333	18400	20000
Apricot	39	9200	8461	9939	7500	9020	11429	12000	12941
Nectarine	59	8770	7994	9546	7200	8000	10000	13333	15000
Peach	238	9565	9246	9885	8000	9798	10800	12500	14222
Cherry	149	11353	10722	11984	8889	11628	13333	15429	17143
Plum	1							15556	17143

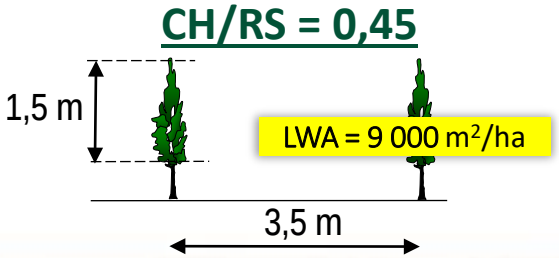
$$\text{LWA} = 18\,000\ m^2/ha \Leftrightarrow \frac{\text{Canopy Height (CH)}}{\text{Row Spacing (RS)}} = 0,9$$



MAX dose



MAX dose - **35%**



MAX dose - **50%**

Dose expression and Dose adjustment

dose expression

PPP mass or volume unit (kg or L) linked to a certain reference unit

dose adjustment

determination (reduction or increase) of the PPP dose to obtain:

- sufficient level of PPP deposit to achieve an expected efficacy under specific circumstances (canopy size and density, application method, controlled organism, climatic factors)
- minimum variation in PPP deposit across a wide range of crop structures,

Dose expression

Harmonization

EPPO General Standard PP 1/239 (2)

Efficacy evaluation of plant protection products

Dose expression for plant protection products

- **„… dose should be expressed in a format that is readily understood by users”**
- **reference units for 3D crops described and discussed**
  - ~~ground area~~
  - ~~spray volume (concentration %)~~
  - canopy height - CH
  - **leaf wall area - LWA**
  - tree row volume - TRV
  - plant row
- **crop structure parameters that need to be measured and recorded**
  - **cropping system** (single or multiple rows);
  - distance **between rows**
  - distance **between plants** in the row
  - treated foliage **height**
  - **mid-width** of the canopy
  - BBCH **growth stage** at application

    as well as:
  - actual applied **spray volume**
  - information on the **application equipment**
- **interconvertability between dose expressions for mutual recognition**

Harmonization

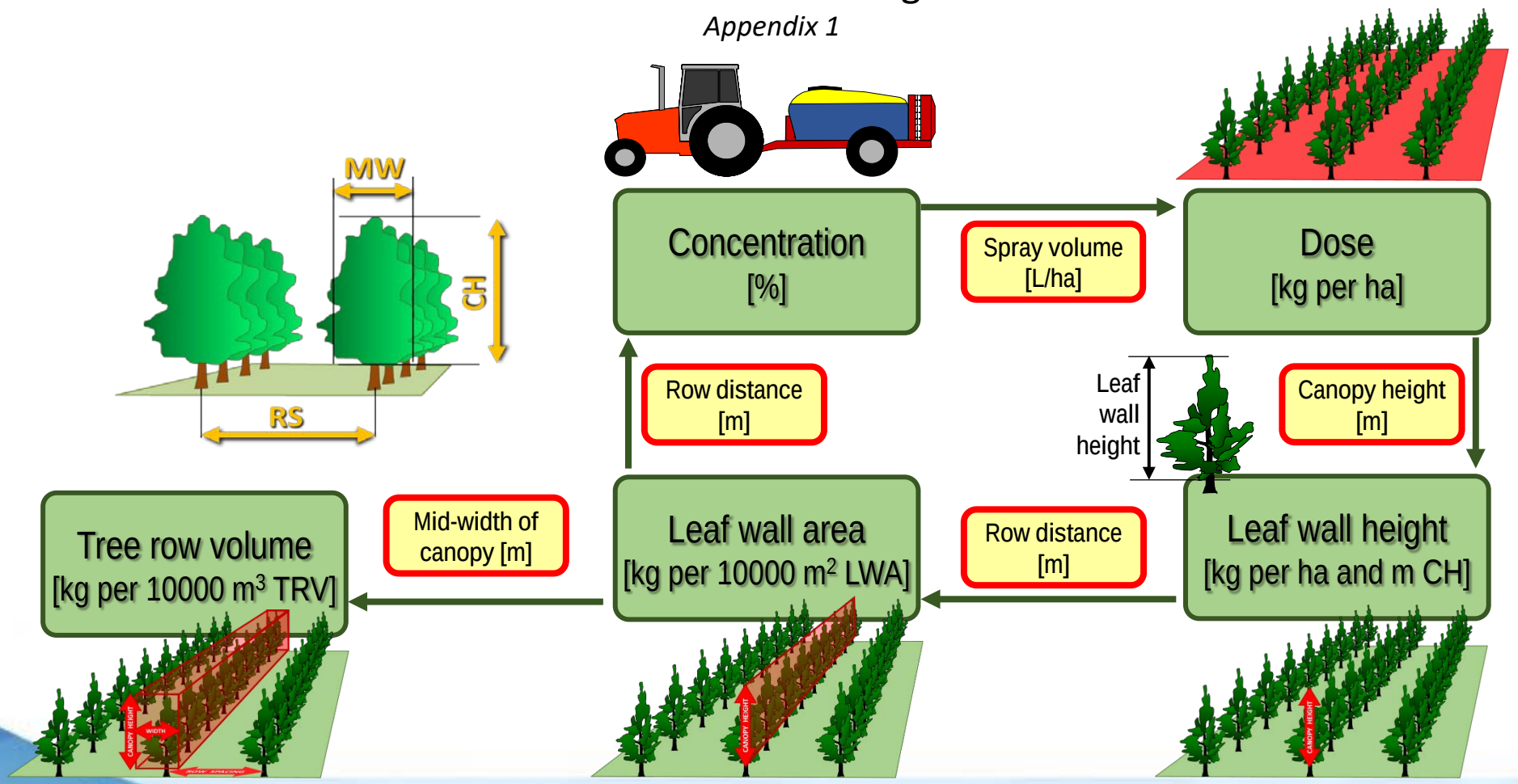
EPPO General Standard PP 1/239 (2)

Efficacy evaluation of plant protection products

Dose expression for plant protection products

Dose convertion diagram

Appendix 1



EPPO Standard PP1/239(2) after: Frießleben et al.,2007.

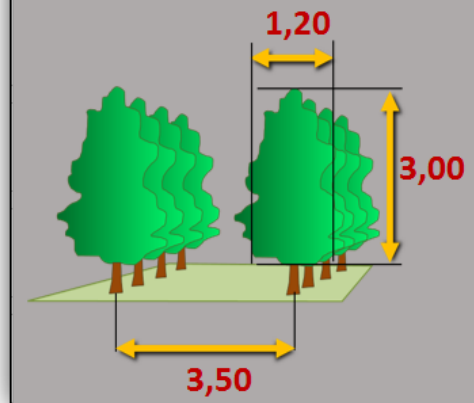
Dose expression

Excel Tool for dose conversion

- request from Organising Committee of EPPO Workshop:

Dose converter

Spray volume [l/ha] 300,00



Concentration [%]	Ground Dose [kg/ha]	CH Dose [kg/ha/mCH]	LWA Dose [kg/10000m^{2}LWA]	TRV Dose [kg/10000m^{3}TRV]
0,15	0,450	0,150	0,263	0,438
0,15	0,450	0,150	0,263	0,438
0,15	0,450	0,150	0,263	0,438
0,15	0,451	0,150	0,263	0,438
0,15	0,451	0,150	0,263	0,438

RESET

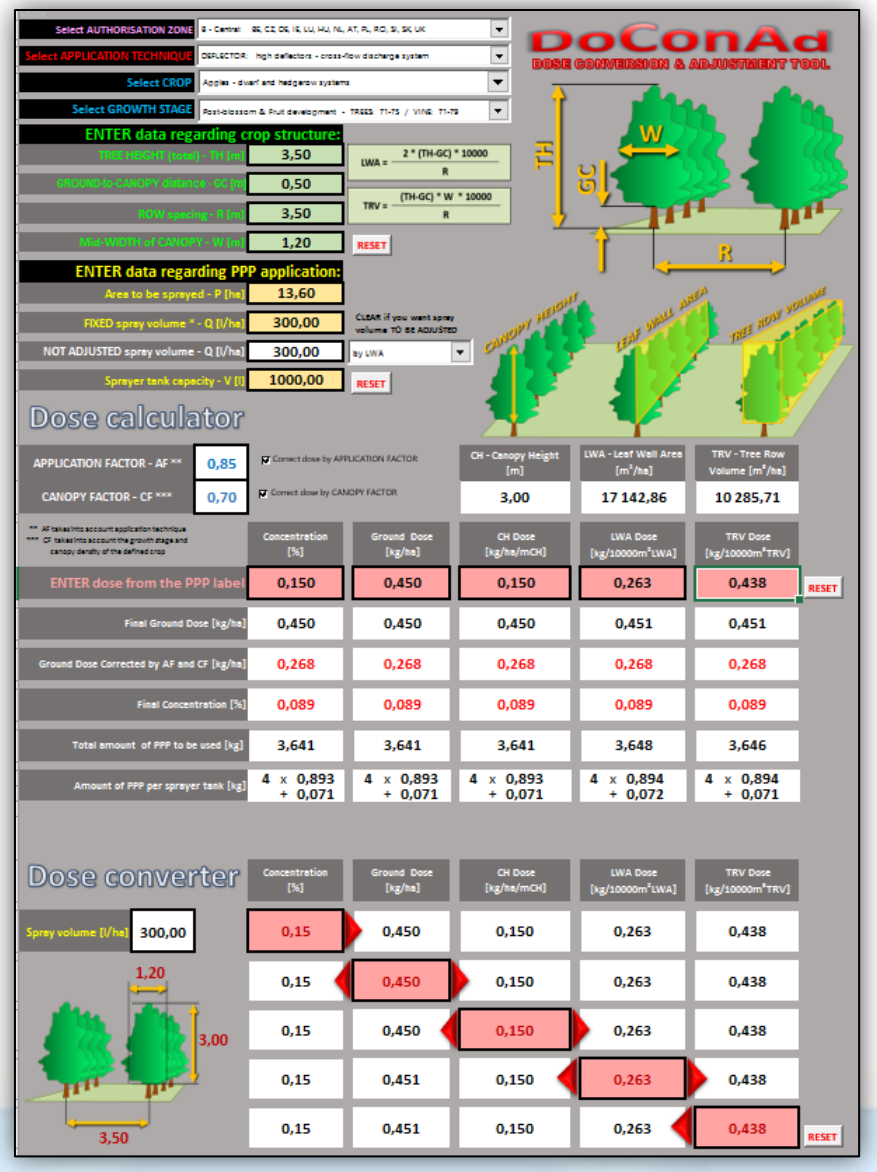
Post-Workshop **EWG – Dose Conversion and Adjustment**

Frank Meier-Runge	- *ECPA*
Santiago Planas	- *Univ. de Lleida, ES*
Patricia Chueca	- *IVIA, ES*
Antonio Miranda Fuentes	- *Univ. de Córdoba, ES*
Sébastien Codis	- *VigneVin, FR*
Paolo Marucco	- *DISAFA, IT*
Elena Gutiérrez	- *INIA, ES*
Evangelos Ch. Karanasios	- *BPI, GR*
Maria da Assunção Prates	- *DGAV, PT*
Riccardo Bugiani	- *Regione E-R, IT*
Greg Doruchowski	- *InHort, PL*

Dose expression

Excel Tool for dose conversion & adjustment

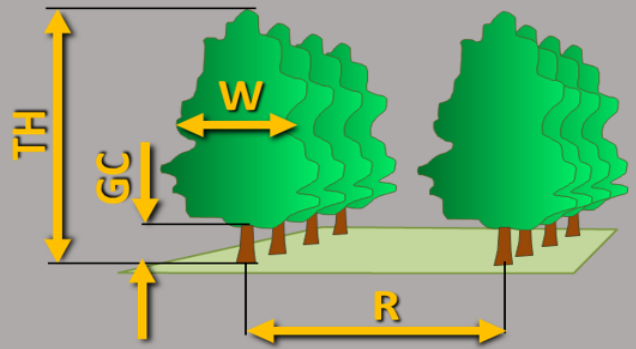
- request from Organising Committee of EPPO Woprkshop



DoConAd

DOSE CONVERSION & ADJUSTMENT TOOL

Select AUTHORISATION ZONE	B - Central: BE, CZ, DE, IE, LU, HU, NL, AT, PL, RO, SI, SK, UK
Select APPLICATION TECHNIQUE	DEFLECTOR: high deflectors - cross-flow discharge system
Select CROP	Apples - dwarf and hedgerow systems
Select GROWTH STAGE	Post-blossom & Fruit development - TREES: 71-75 / VINE: 71-79



ENTER data regarding crop structure:

TREE HEIGHT (total) - TH [m]	3,50
GROUND-to-CANOPY distance - GC [m]	0,50
ROW spacing - R [m]	3,50
Mid-WIDTH of CANOPY - W [m]	1,20

$$LWA = \frac{2 * (TH-GC) * 10000}{R}$$

$$TRV = \frac{(TH-GC) * W * 10000}{R}$$

RESET

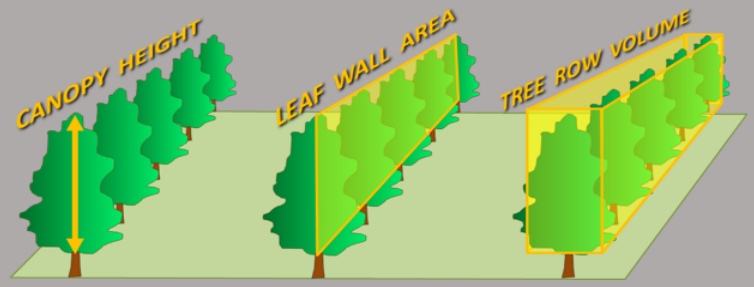
ENTER data regarding PPP application:

Area to be sprayed - P [ha]	13,60
FIXED spray volume * - Q [l/ha]	300,00
NOT ADJUSTED spray volume - Q [l/ha]	300,00
Sprayer tank capacity - V [l]	1000,00

CLEAR if you want spray volume TO BE ADJUSTED

by LWA

RESET



Dose calculator

APPLICATION FACTOR - AF **	0,85	Correct dose by APPLICATION FACTOR
CANOPY FACTOR - CF ***	0,70	Correct dose by CANOPY FACTOR

CH - Canopy Height [m]	LWA - Leaf Wall Area [m^2/ha]	TRV - Tree Row Volume [m^3/ha]
3,00	17 142,86	10 285,71

** AF takes into account application technique
*** CF takes into account the growth stage and canopy density of the defined crop

	Concentration [%]	Ground Dose [kg/ha]	CH Dose [kg/ha/mCH]	LWA Dose [kg/10000m^2LWA]	TRV Dose [kg/10000m^3TRV]
ENTER dose from the PPP label	0,150	0,450	0,150	0,265	0,438
Final Ground Dose [kg/ha]	0,450	0,450	0,450	0,454	0,451
Ground Dose NOT Corrected [kg/ha]	0,450	0,450	0,450	0,454	0,451
Final Concentration [%]	0,150	0,150	0,150	0,151	0,150
Total amount of PPP to be used [kg]	6,120	6,120	6,120	6,178	6,127
Amount of PPP per sprayer tank [kg]	4 x 1,500 + 0,120	4 x 1,500 + 0,120	4 x 1,500 + 0,120	4 x 1,514 + 0,121	4 x 1,502 + 0,120

RESET

Factors determining dose adjustment

Target

- **Dimentions of target**
  - height
  - width
  - row spacing
- **Canopy density**
  - LAI [m^2/m^2]
  - projected area [%]
  - area density [m^2/m^3]
  - pictogram
- **Growth stage**
  - BBCH
  - selected from list of options
- **Specie / Variety of crop**
- **Controlled pest or pathogen**
  - level of infection risk
  - level of infection or infestation
  - stage of development
  - dynamics of development
  - behaviour
  - place and mode of feeding

Plant Protection Product

- **Type of product**
  - fungicide
  - insecticide
  - acaricide
- **Purpose of treatment**
  - preventive
  - curative
- **Mode of action**
  - contact
  - systemic
  - translaminar

Application technique

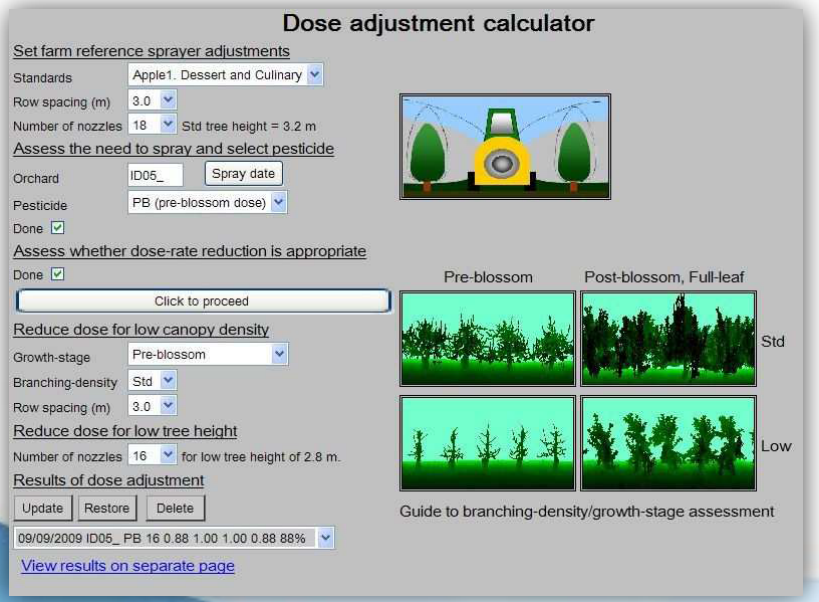
- **Sprayer type**
- **Nozzle type**

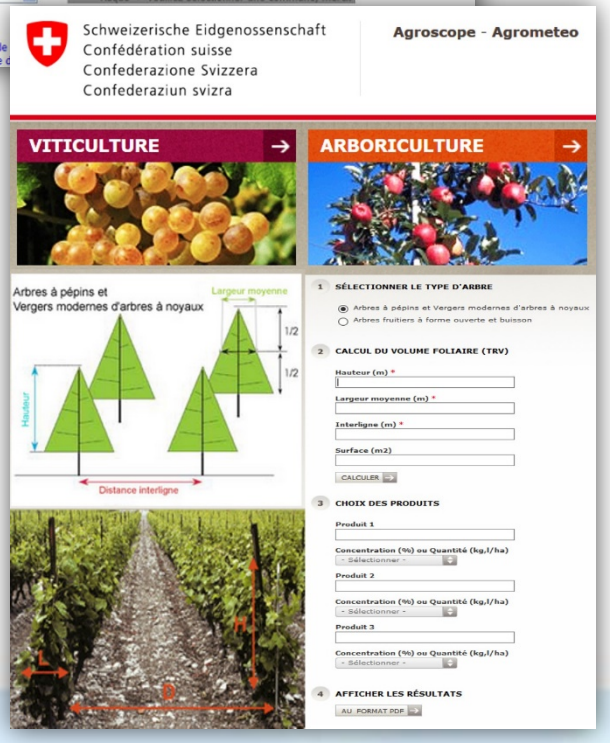
Weather Conditions

- Air temperature
- Relative humidity
- Wind velocity
- Cloud cover
- Haze

Dose adjustment

Decision suport tools





- **DOSAVIÑA**
- **OPTIDOSE**
- **PACE**
- **DOSAGE ADAPTE**