



Experimental modelling of spray deposit according to vine canopy architecture to design scenarios for dose expression and adjustment

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Context

- The LWA (Leaf Wall Area): new unit for efficacy trials for registration of PPP for 3D crops (orchards and vineyards)

- French national action Plan Ecophyto

Objective: reduce by 50% the use of plant protection products (PPP) in 2025



Dose expression: a potentially strong lever to reduce the use of PPP

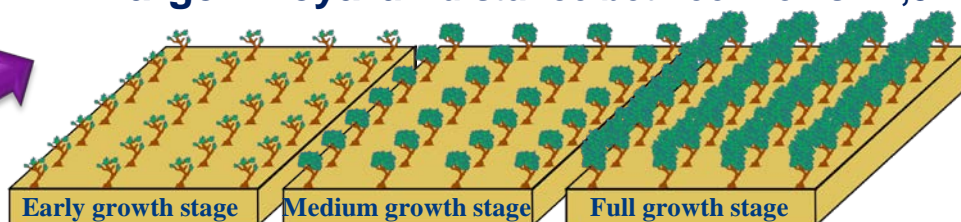
- Vine dose rate expression in France:

Today, the registered dose rate in viticulture is **fixed and defined in g or L per ha cadastral treated**.

This dose does not take into account the **structure of the canopy** neither the **training system**.

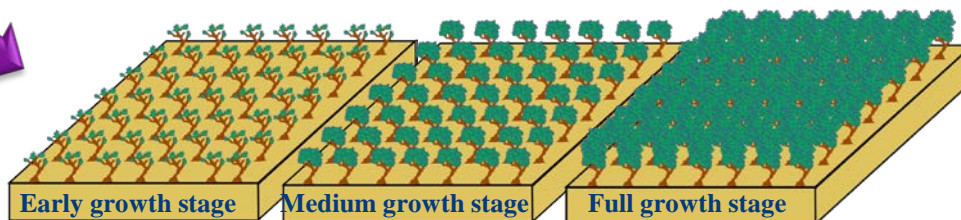
1 single
dose
per
hectare

Large vineyard : distance between rows : 2,5 m



LWA max = 12000 m²/ha

Narrow vineyard : distance between rows : 1,0 m



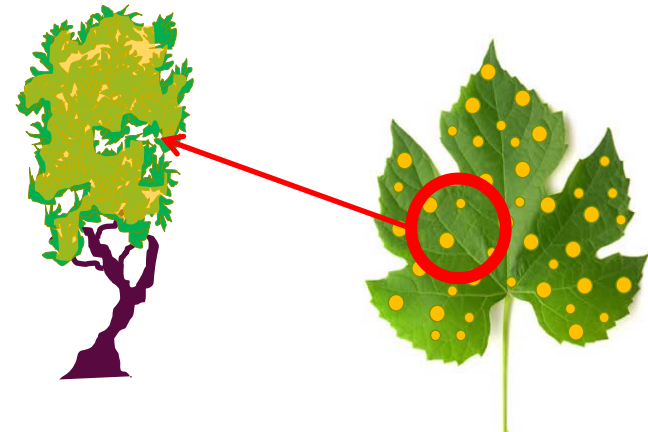
LWA max = 24000 m²/ha

Motivations

- A new system of dose expression (LWA)
- The leaf area to be treated increases significantly during the season
- Variable performance of sprayers

What are the consequences of dose expression change on the effective dose ?

« Effective dose »



unit = ng/dm²

Materials and methods

Crop parameters measurements

Deposition measurements

- 2 years of experiments (2016 and 2017)
- Measurements at 4 dates during the season
- 10 contrasted plots: grape variety, vigour
- Manuals measurements: height, thickness, growth stage



CROP PARAMETERS
LWA: Leaf Wall Area
TRV: Tree Row Volume

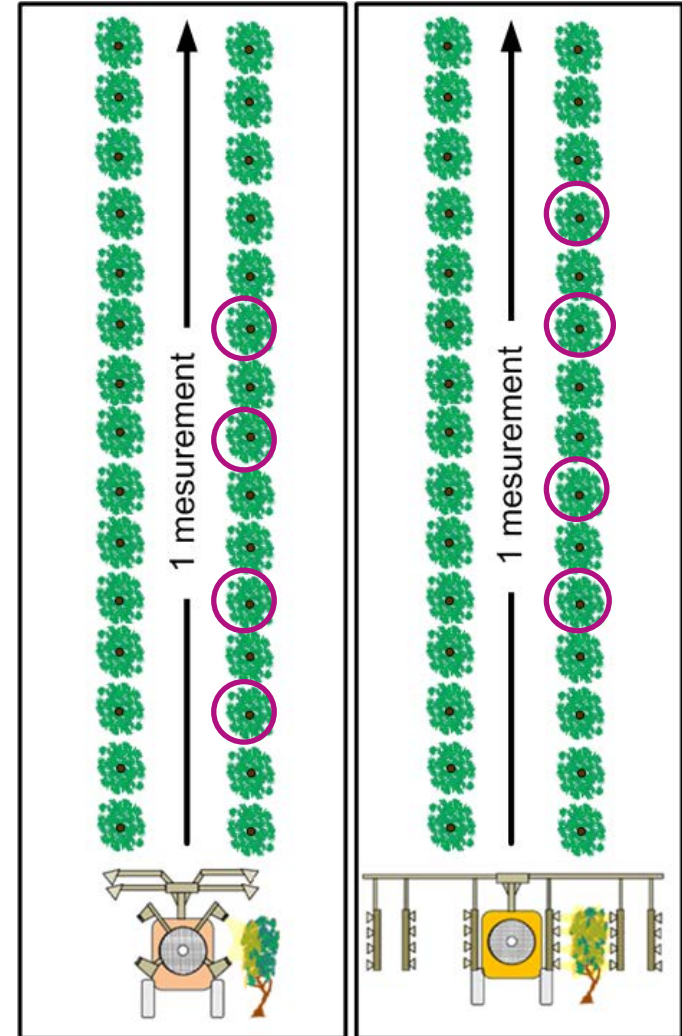


Spray deposit measurement



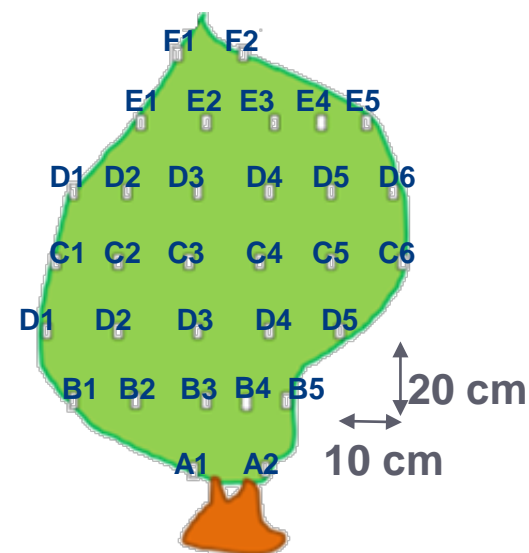
2 sprayers were used:

- A **pneumatic arch sprayer** used **every 4 rows** (low performance sprayer)
- An **air assisted side by side sprayer** (high performance sprayer)



Spray deposit measurement

- Using a tracer Tartrazine E102
- Methodology ISO22522:2007
- Measurement of **deposit per unit area** (ng/dm² for 1g/ha applied) on a grid perpendicular to the row
- 7000 collectors** individually analysed
- Assessment of mean deposit and distribution**



Grid used for deposit measurement sampling: one collector per cell



PVC collectors positionned on leaves

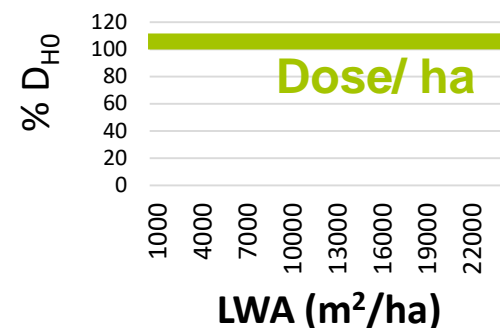
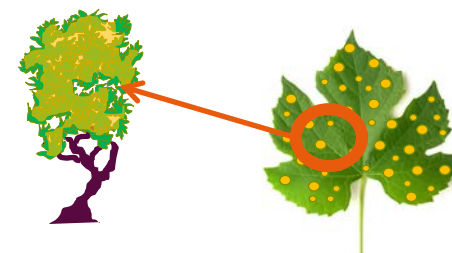
	Prof.1	Prof.2	Prof.3	Prof.4	Prof.5	Prof.6
Hauteur G						
Hauteur F	407,1622	339,34	402,533	113,885	370,821	
Hauteur E	363,6452	167,355	145,365	202,539	127,079	206,706
Hauteur D	152,7726	91,2006	581,925	165,735	510,631	131,014
Hauteur C	138,4213	170,133	51,8501	268,972	52,776	190,503
Hauteur B	115,0424	99,5337	262,26	64,5812	74,0716	196,521
Hauteur A	125,9217	122,913	56,2481	81,0158		

Scenarios for dose adjustment

Question: what is the impact of switching from a dose per hectare to a dose adjusted to LWA on the deposit ?

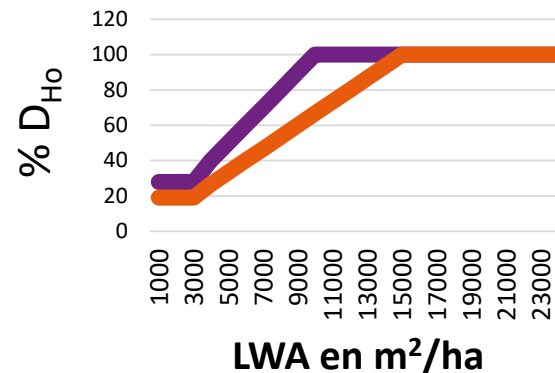
H₀: fixed dose rate (current dose expression in France D_{H0}) :

ex: 1g/ha



H₁: the dose is linearly adjusted to LWA with a LWA_{max} = 10 000m²/ha

ex: 1g/ha for 10 000m²/ha
0.5g/ha for 5000m²/ha



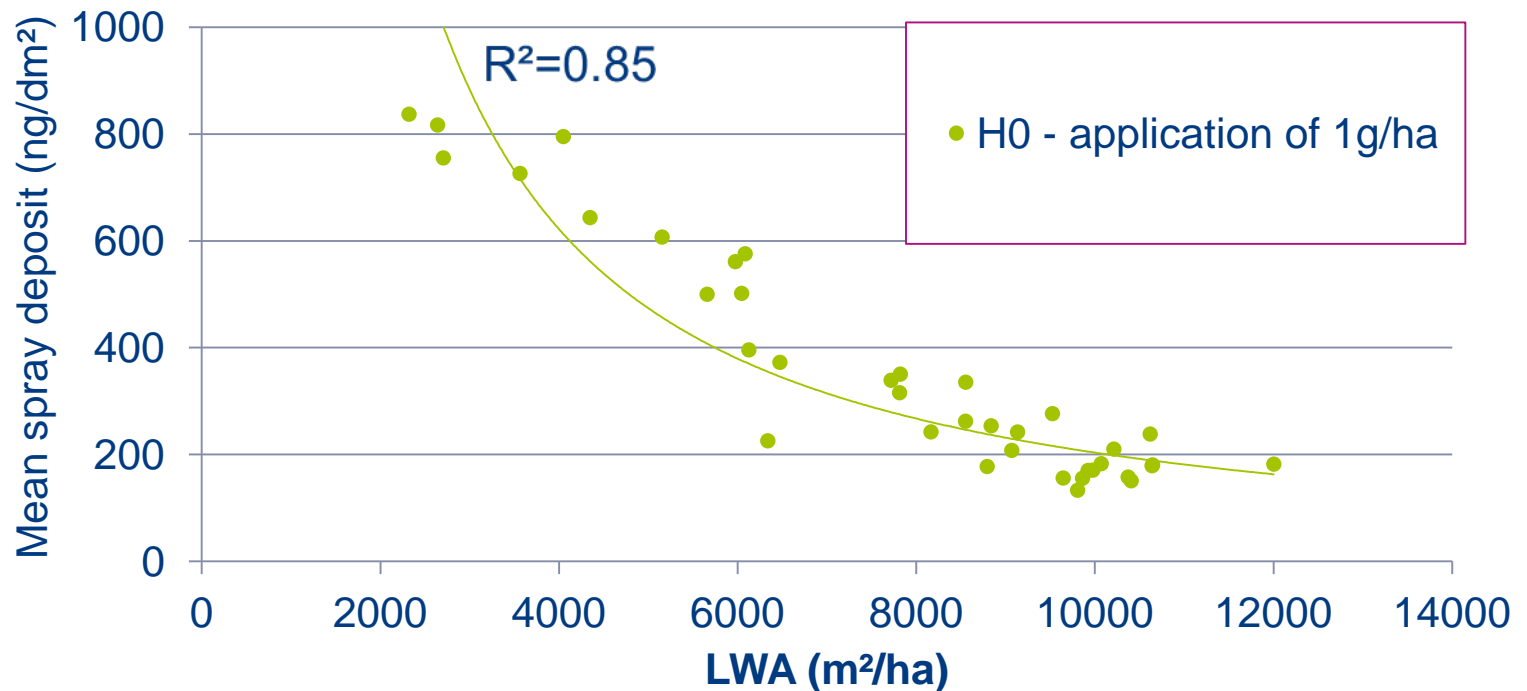
H₂: the dose is linearly adjusted to LWA with a LWA_{max} = 15 000m²/ha

ex: 1g/ha for 15 000m²/ha
0.66g/ha for 10 000m²/ha
0.33g/ha for 5000m²/ha



Result: relations between mean spray deposit and crop parameters

Side by side sprayer

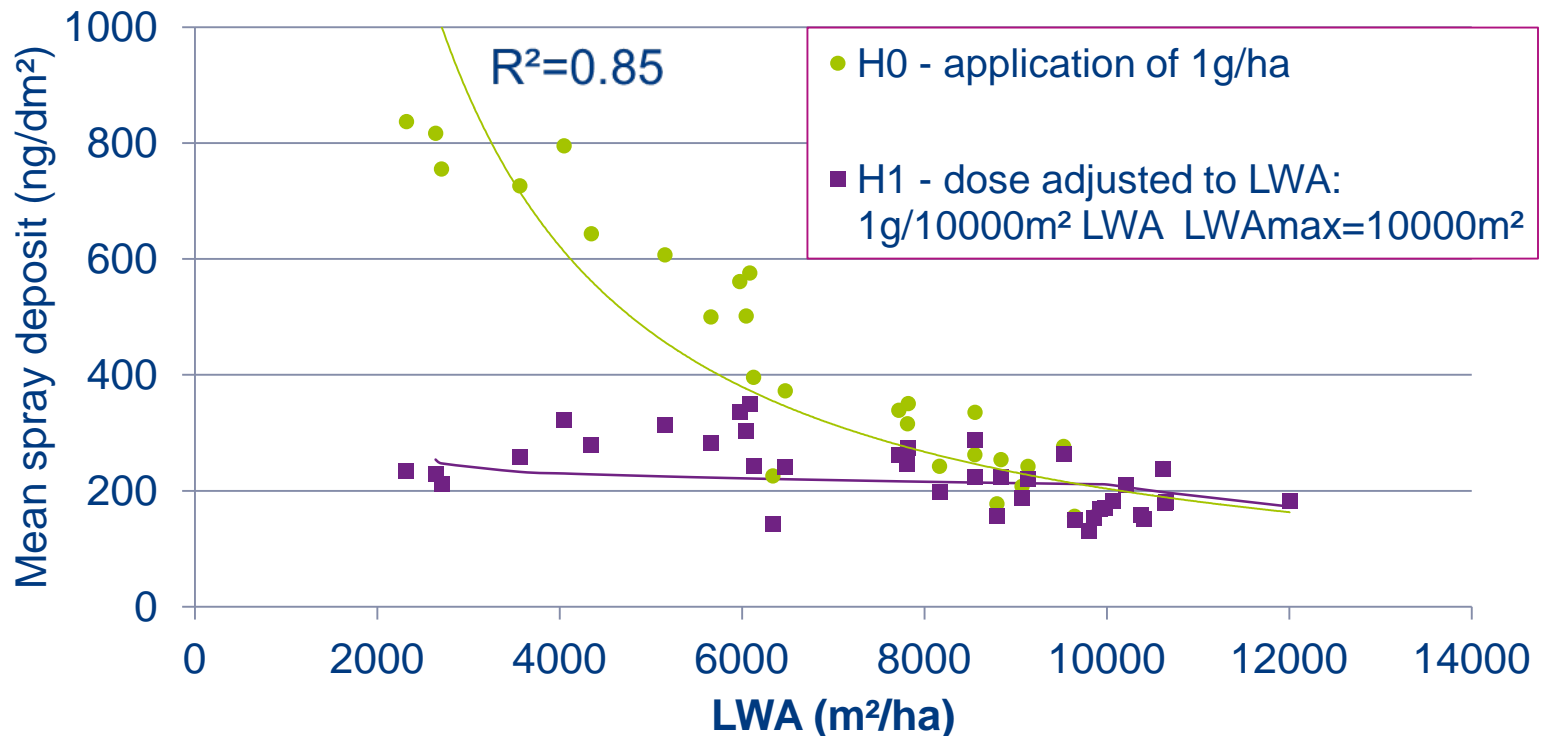


Mean spray deposit: four times greater for early growth stage than for full growth stage.

→ potential reduction of applied PPP dose rate

Result: relations between mean spray deposit and crop parameters

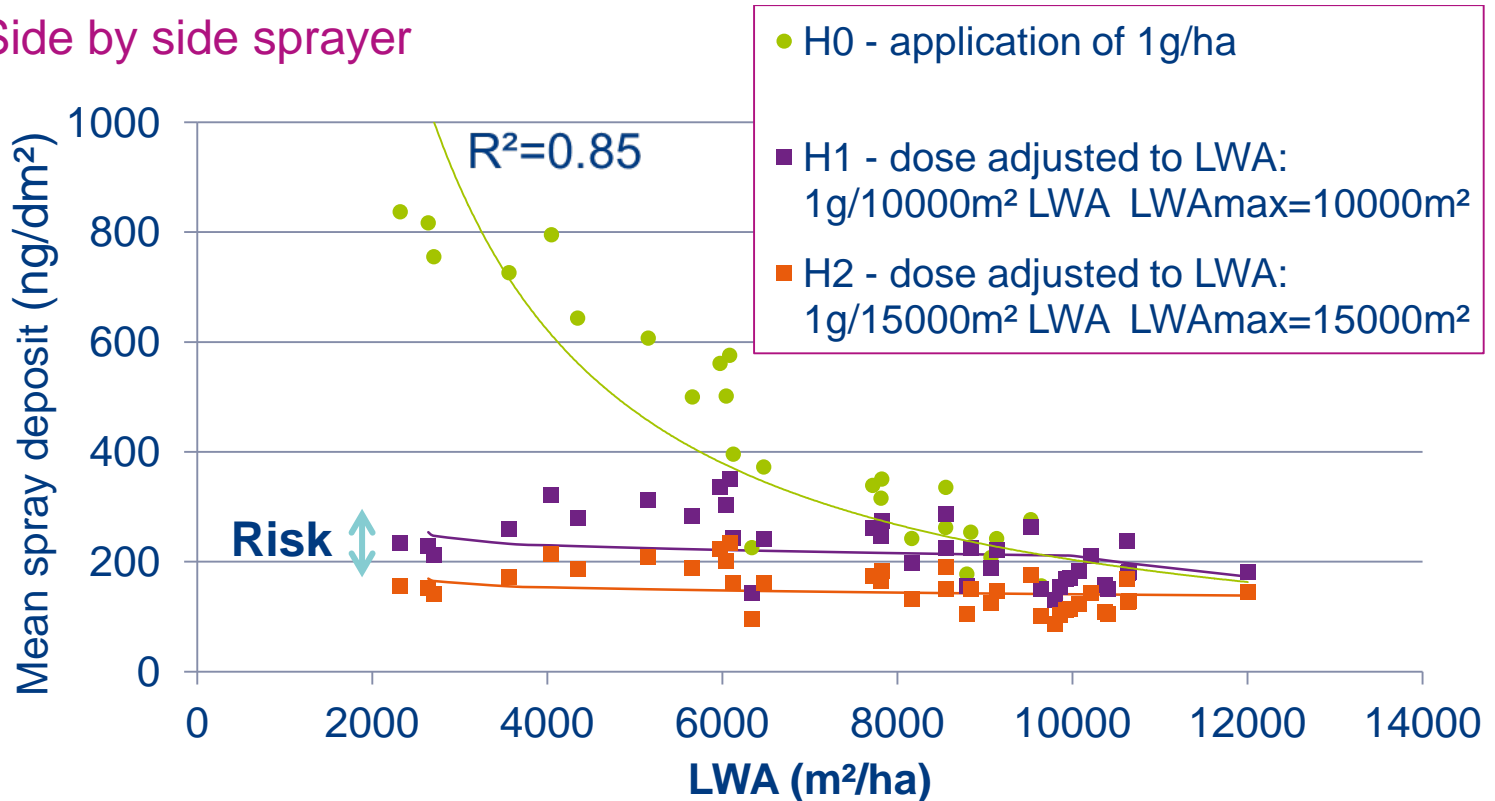
Side by side sprayer



LWA adjusted doses insured an almost constant spray deposit per unit area in the canopy

Result: relations between mean spray deposit and crop parameters

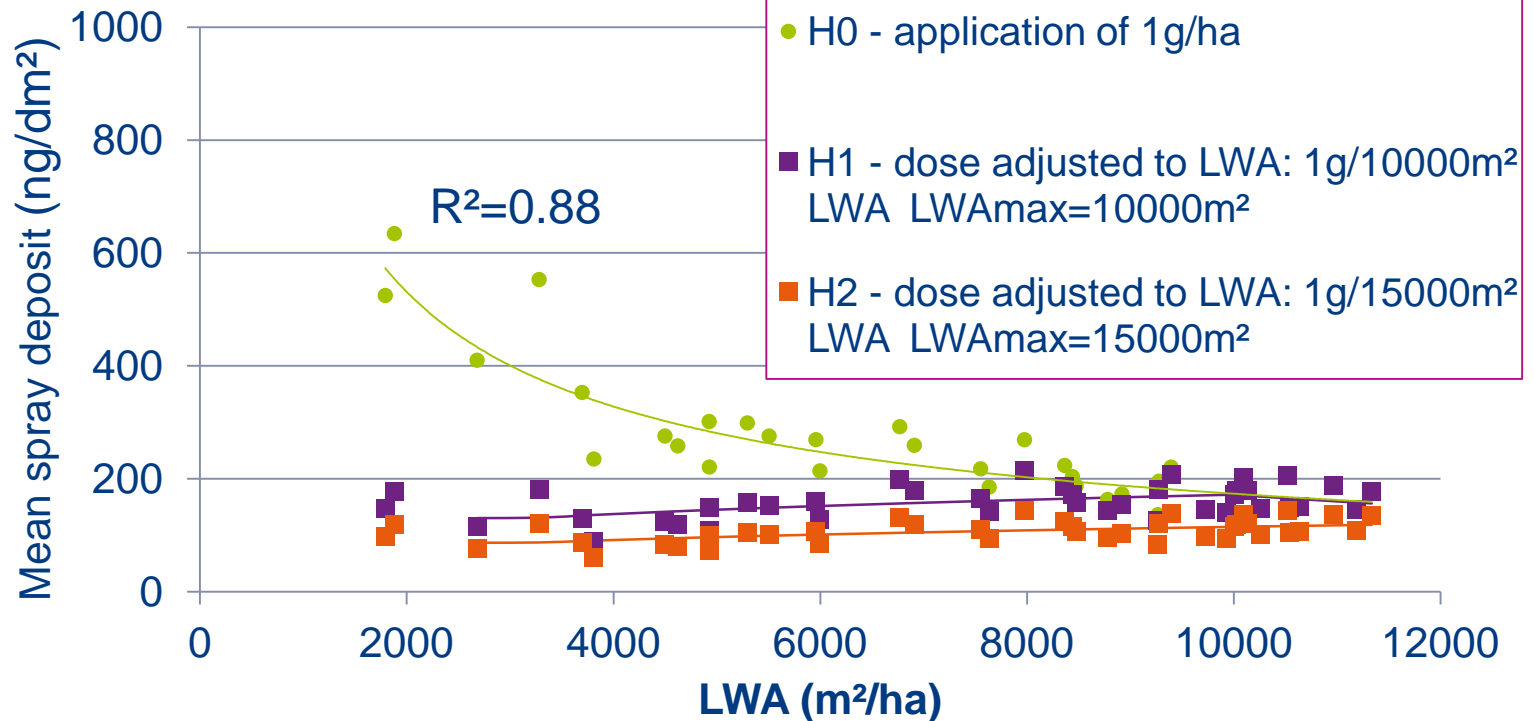
Side by side sprayer



The choice of LWAmax has consequences in terms of mean spray deposit during the season

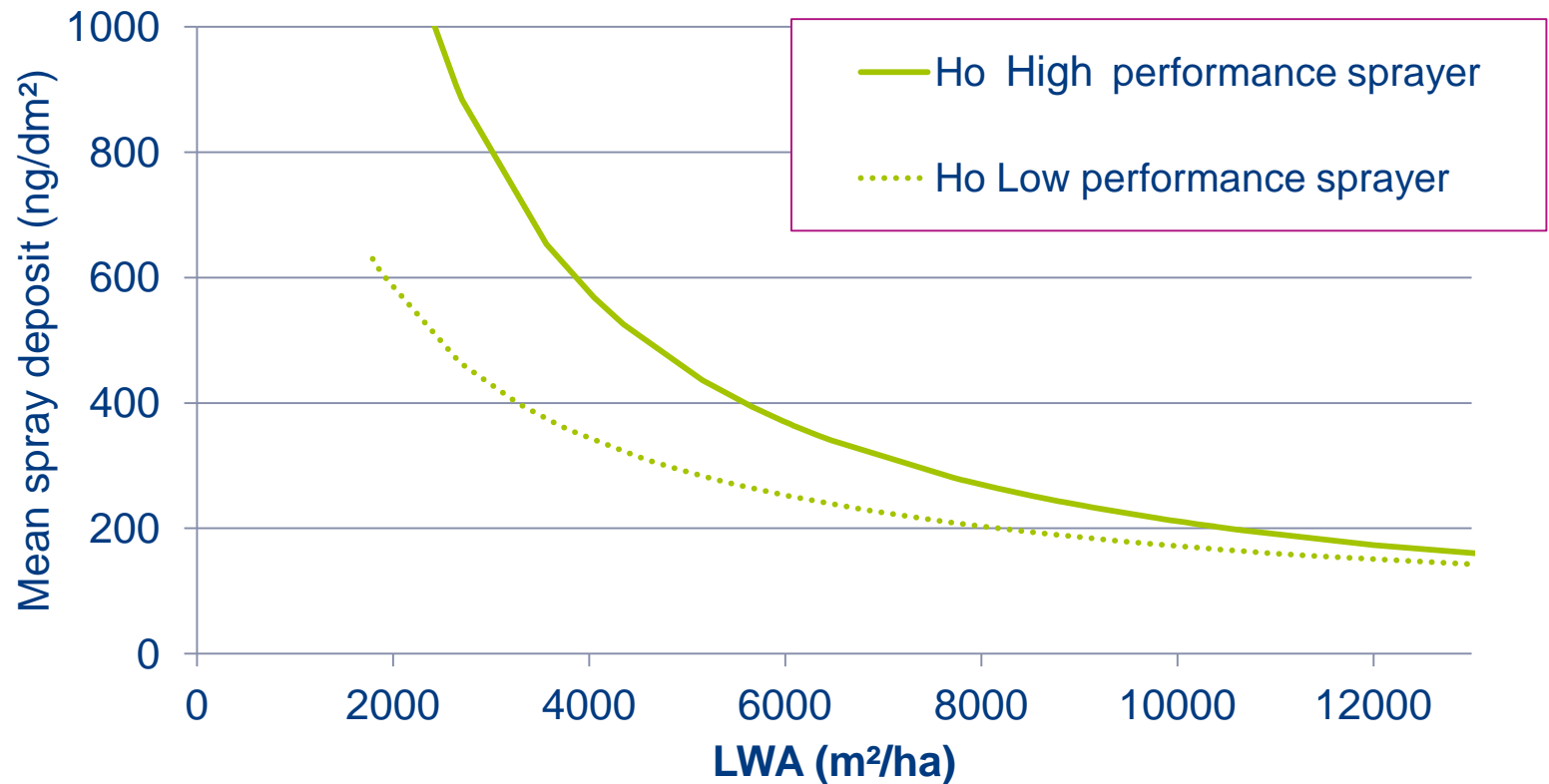
Result: relations between mean spray deposit and crop parameters

Pneumatic arch sprayer every 4 rows

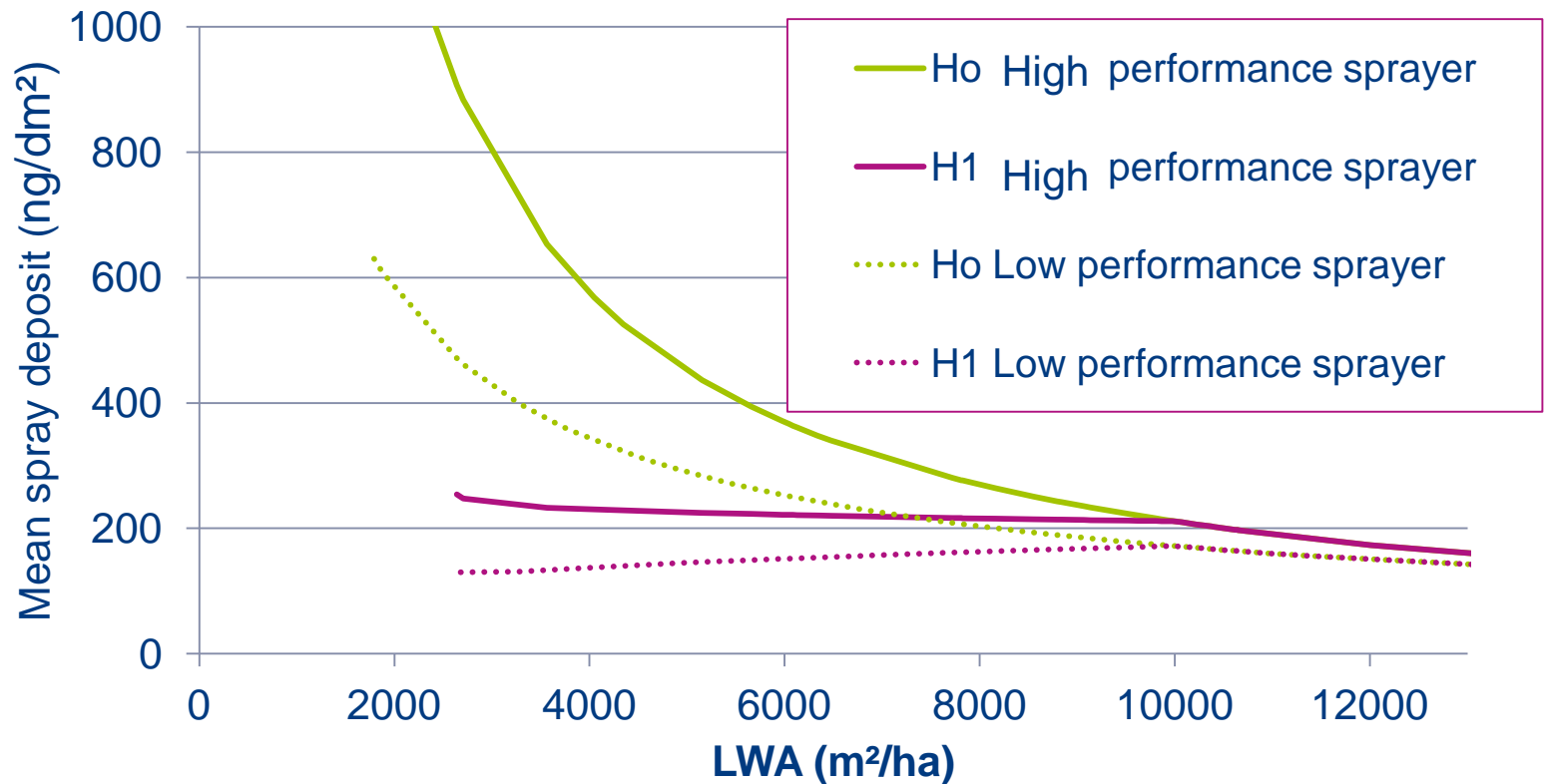


LWA adjusted dose insured a constant spray deposit
 Mean spray deposit is lower with a low performance sprayer than with the high performance sprayer

Result: comparison between sprayers



Result: comparison between sprayers



For field use: build dose adjustment tables

These models may also be used as a basis to create LWA based dose adjustment tables in order to provide guidance on product labels

Dose in L or kg/ha ground		Treated height			
		Inferior to 1 m	1 m – 1,3 m	1,3 m – 1,6 m	Superior to 1,6 m
Inter- row spacin g	1 to 1,60 m	1 kg/ha	1,3 kg/ha	1,5 kg/ha	<u>1,8 kg/ha</u>
	1,60 to 2,5 m	0,7 kg/ha	1,1 kg/ha	1,3 kg/ha	1,5 kg/ha
	Superior to 2,5 m	0,5 kg/ha	0,9 kg/ha	1,1 kg/ha	1,3 kg/ha

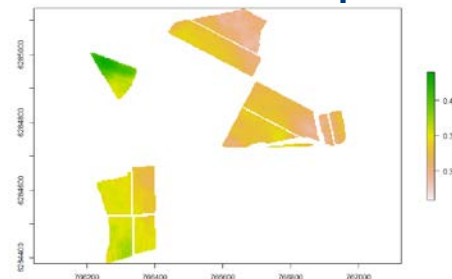
Example of a dose adjustment table for product already registered

Conclusion

- In our experimental conditions (large vineyard, Mediterranean area), spray deposit could be predicted according to Leaf Wall Area
- Experimental data of spray deposit quantify consequences of the change of dose expression

Next steps:

- Measurements in narrow vineyard conditions
- Towards precision spraying: use sensors to bring a dose adapted to the characteristics of the plant





Thanks for your attention !

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