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Giuseppe Pellizzi Prize 2024

33rd Members' Meeting of the Club of Bologna

November 10, 2024

Towards a sustainable use of plant protection products in orchards: Implementation of canopy-adapted spray technology and new developments for spray efficiency evaluation

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Education:

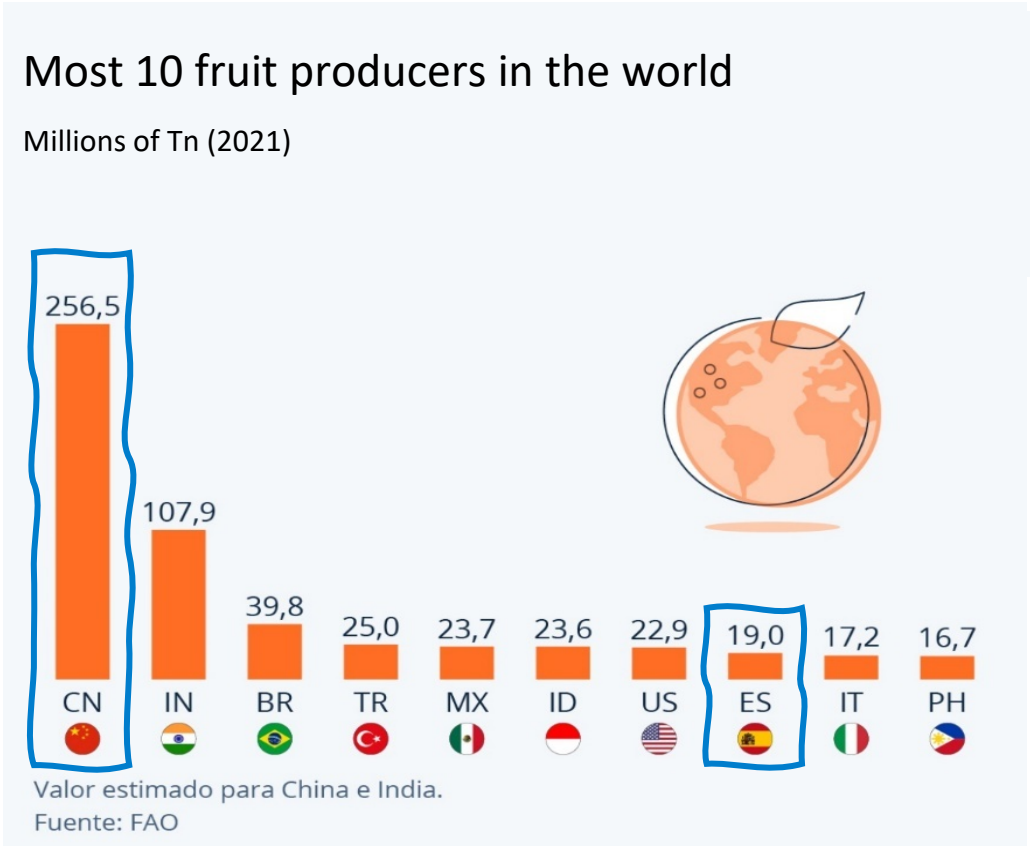
- 2012.9—2016.6 Bachelor Degree,
  Mechanical Design Manufacture and Automation Major,
  Wuhan Institute of Technology
- 2016.9—2019.6 Master Degree, Vehicle Engineering,
  South China Agricultural University
- 2019.9—2024.3 PhD, Agricultural Engineering,
  Universitat Politècnica de Catalunya

Personal honors:

- Scholarship for PhD student under the State Scholarship Fund by the China Scholarship Council (2019.9-2023.9)

Research field: Precision pesticide application in orchards

Why orchards?



Drift losses

Evaporation losses

Ground losses

On the intended target

❑ Off-target losses can reach 70%

(Balsari et al., 2002) (Miranda-Fuentes et al., 2019)

Difficulties for spraying applications in orchards

Large variability in canopy structure and volume

- Growth stage
- Pruning method
- Training system
- Crop type

V-hedge Classic T-hedge

(Duga et al., 2015)

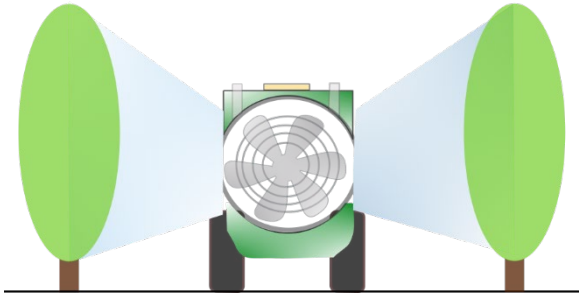
Different spraying applications

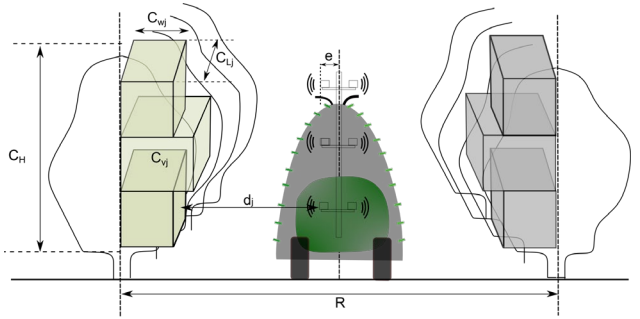
Conventional application ***vs*** **Canopy-adapted application**

Optimized application

Precise application

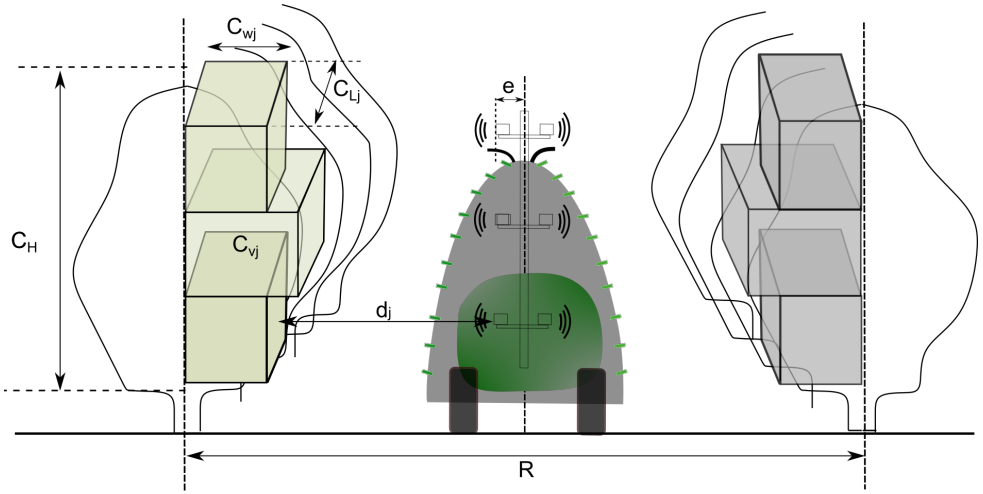
Doruchowski, G. 2018





- When specific to crops and sprayers, the potential improvement in spray quality of the canopy-adapted applications?
- To what extent the PPPs can be saved in orchards when the canopy-adapted applications were introduced?

Developed variable rate sprayer



Experimental setup

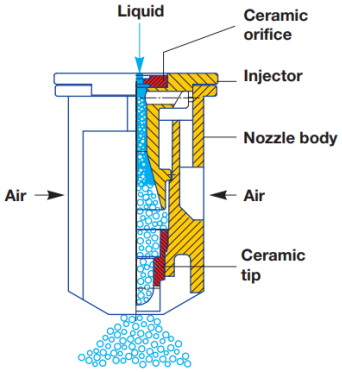
Variety: Royal Gala

Training method: fruit wall system

Parameters	Growth stage	
	BBCH72	BBCH99
Row distance (m)	4.15	4.15
Canopy height (m)	2.00 ± 0.19	2.06 ±0.33
Canopy width (m)	0.89 ± 0.1	1.01 ± 0.10
TRV (m^3 ha^{-1})	4289	5013
LWA (m^2 ha^{-1})	9639	9927

Working parameters of three treatments

Spraying application	Parameters					
	Vol. (L ha^{-1})	Vel. (km h^{-1})	Nozzle (No.)	Nozzle (type)	Pressure (bar)	Droplet size*
Hardi tower sprayer (REF)	883	5.5	10+8	ATR Orange/Red	14	VF
Fede axial-fan sprayer (BMP)	775	5.0	10	TVI Blue	15	VC
Fede tower sprayer (PRE)	517 (72) / 492 (99)	5.0	20	IDK90-015	4-14	VC



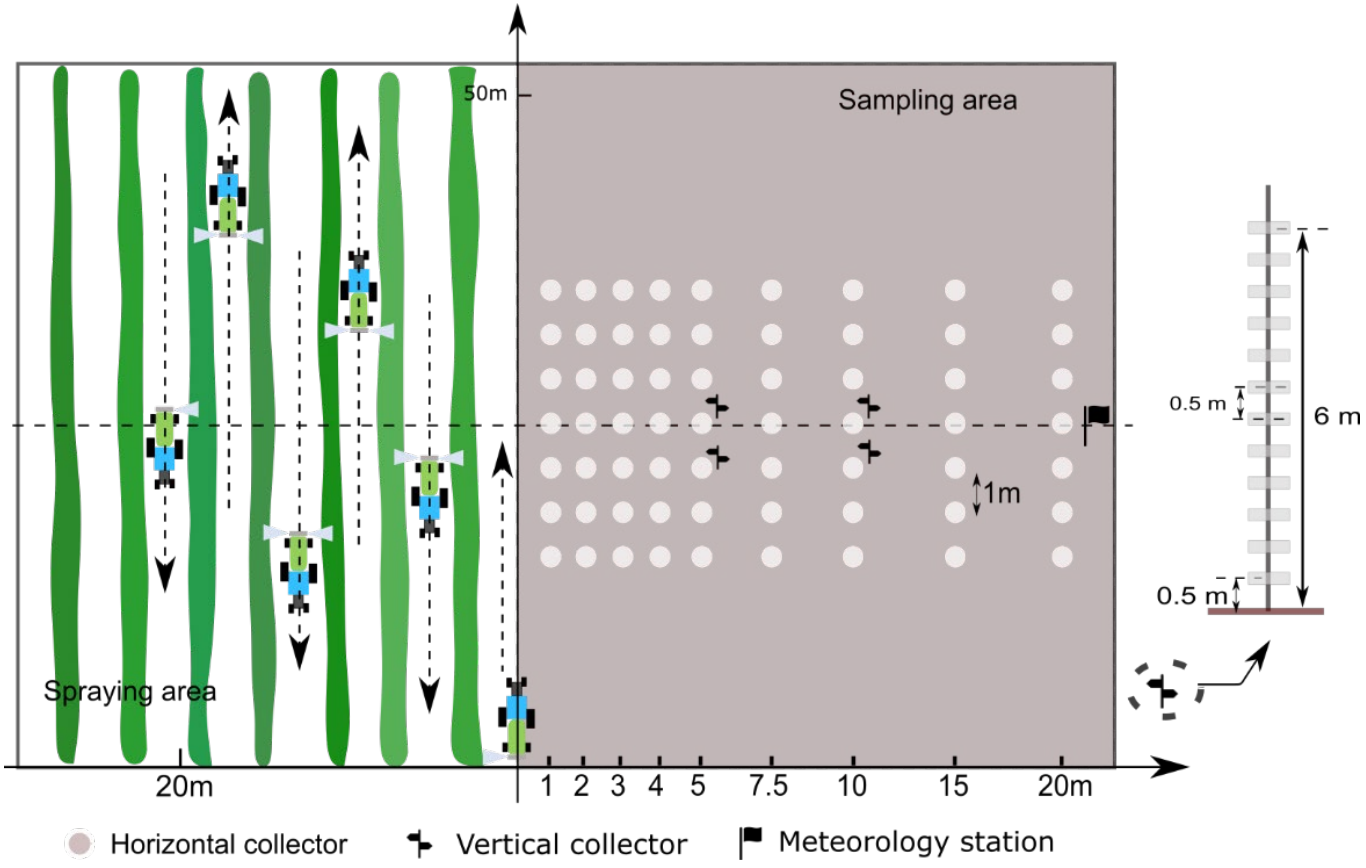
0.16 L/m^3 TRV

12% reduction

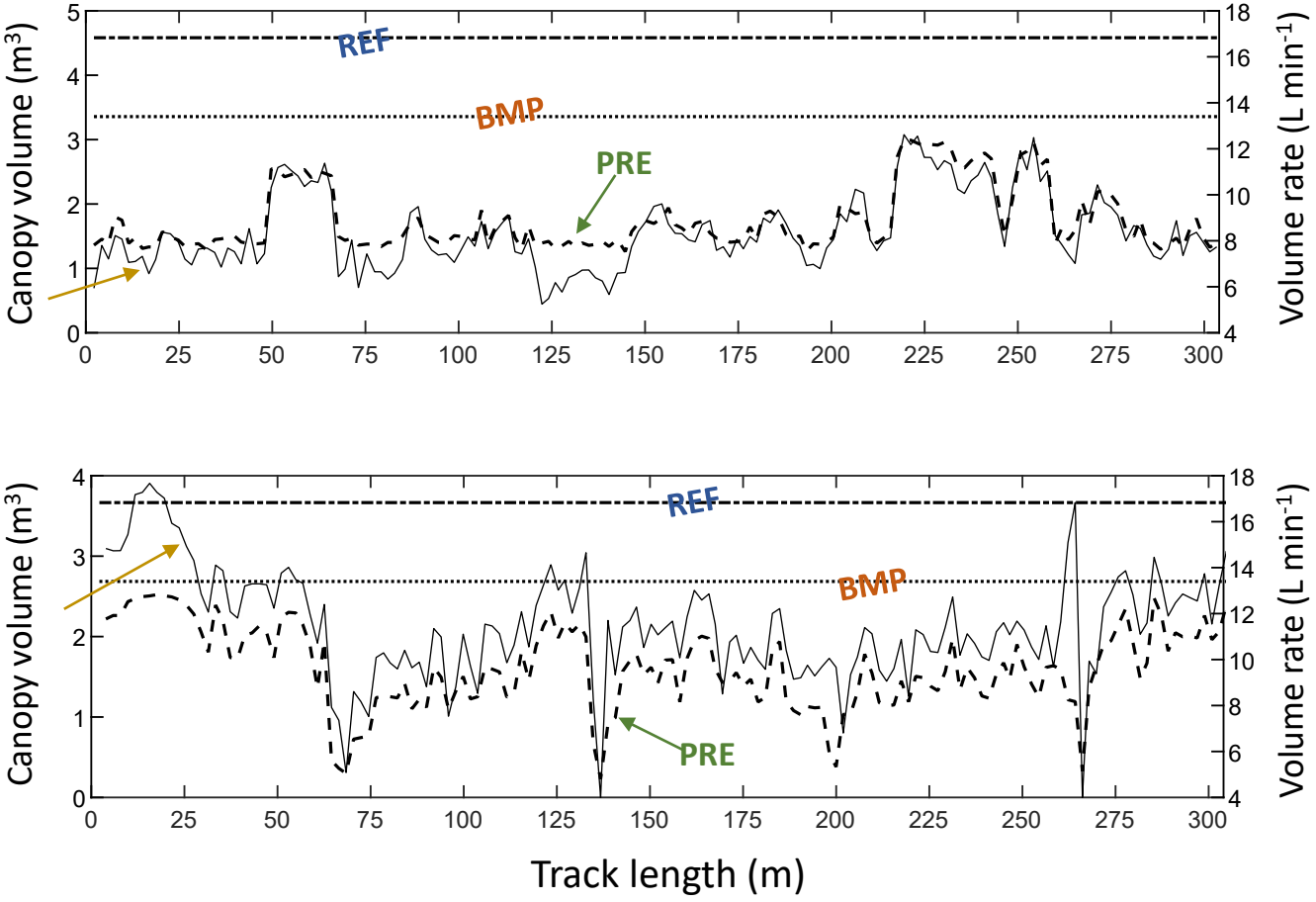
0.1 L/m^3 TRV

43% reduction

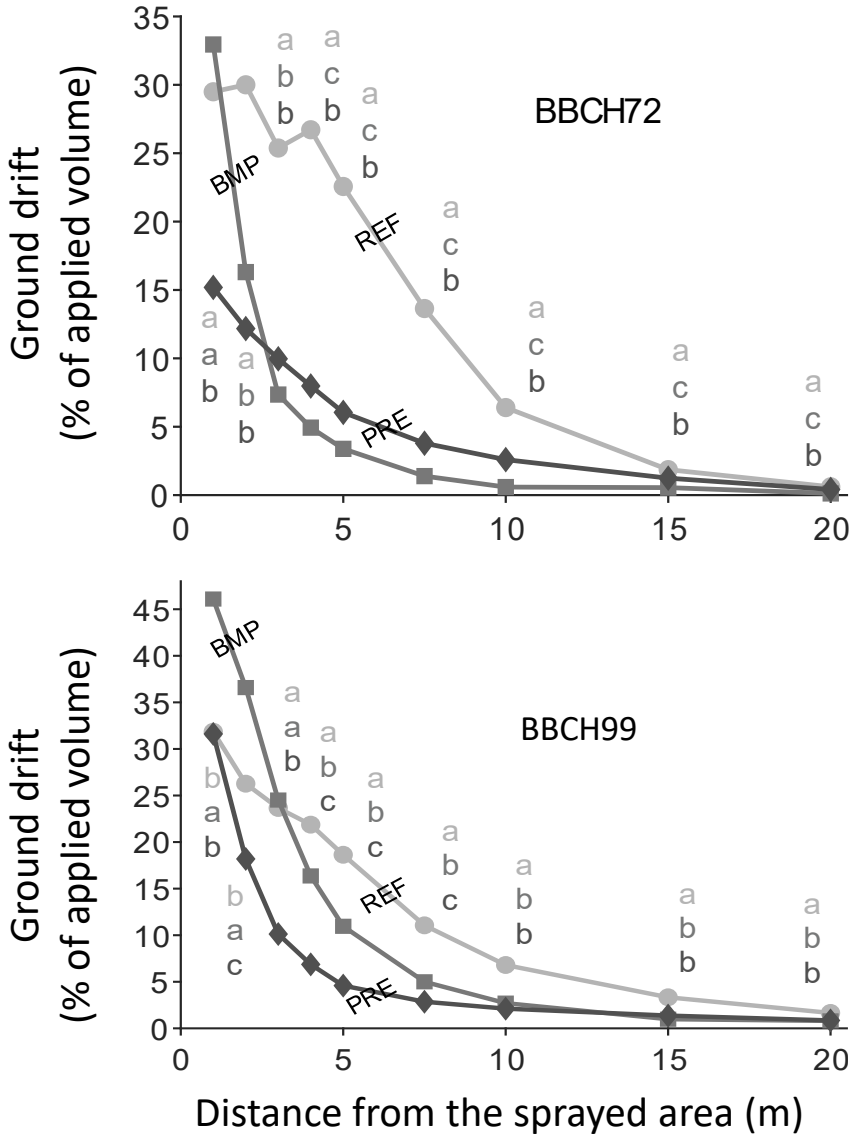
Spray drift trials following the ISO 22866:2005(E)

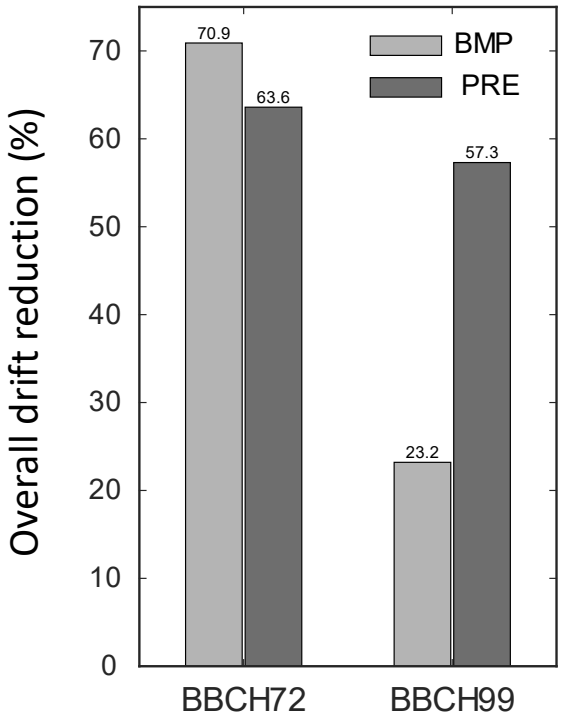


Canopy volume and corresponding output spray rate

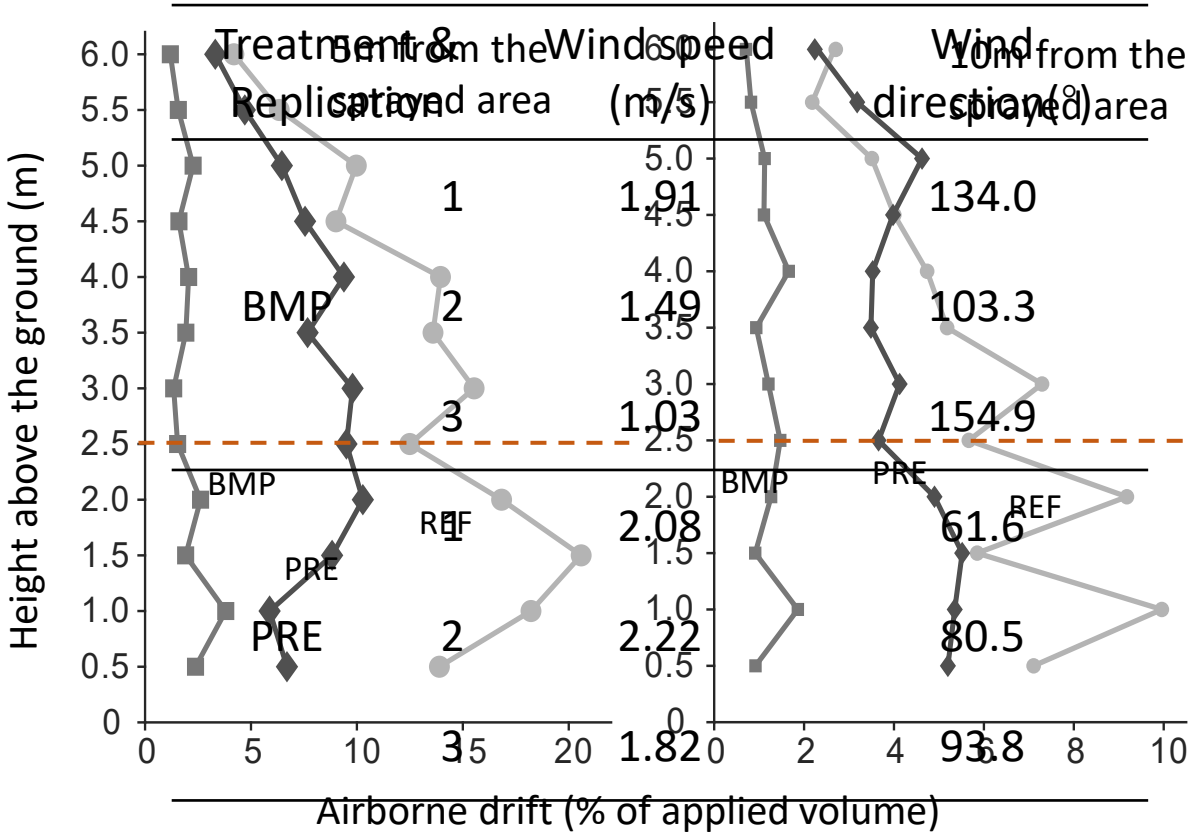


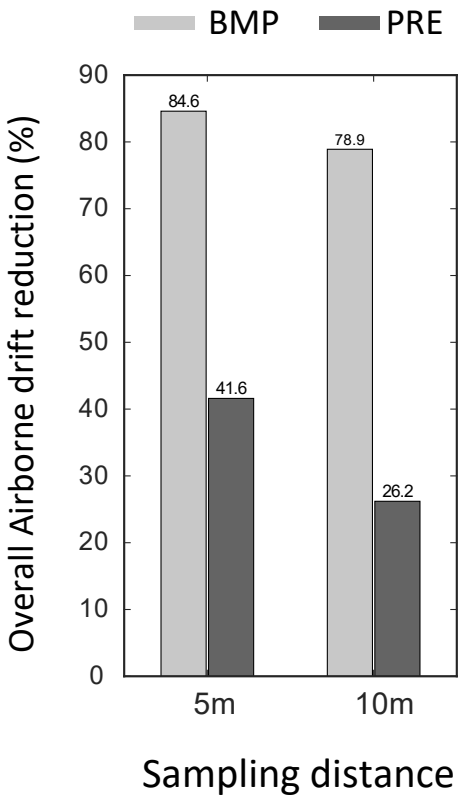
Ground drift profiles



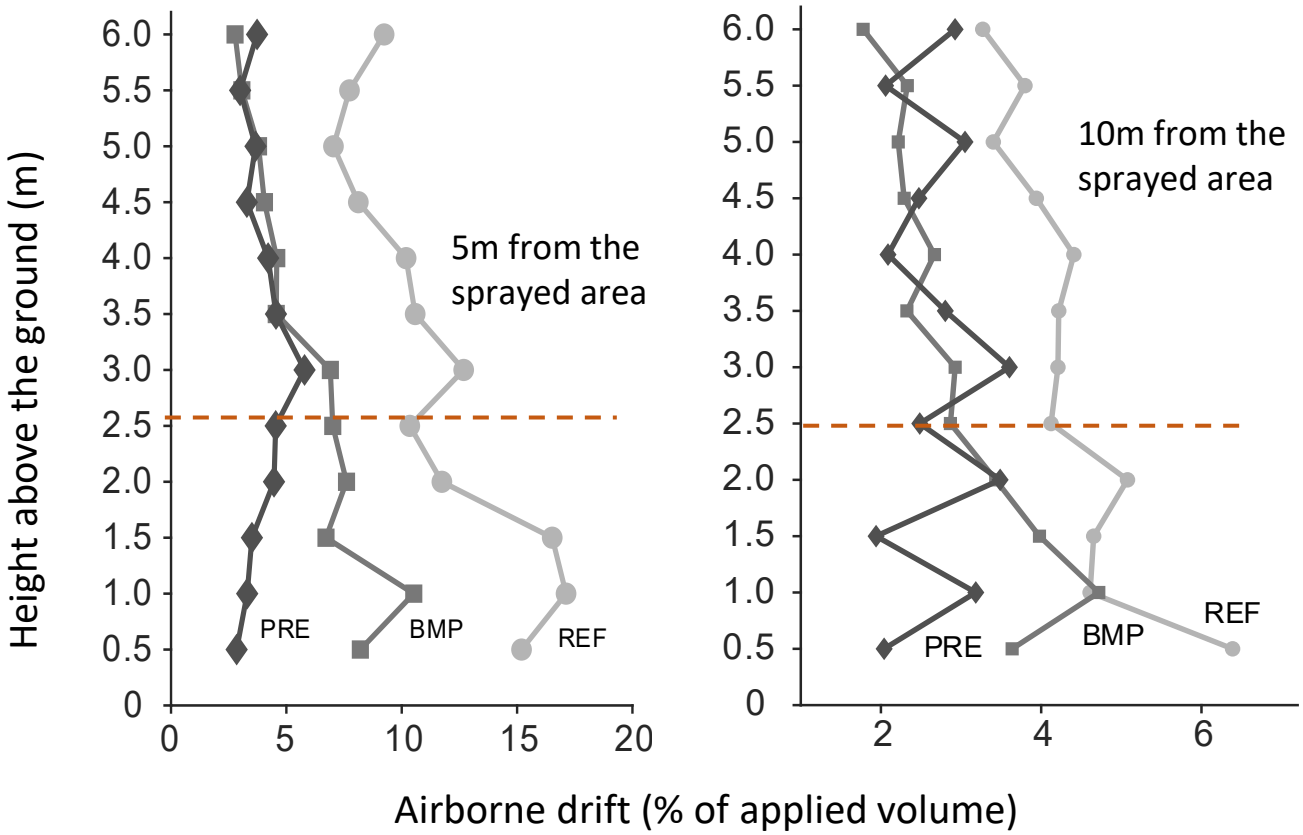


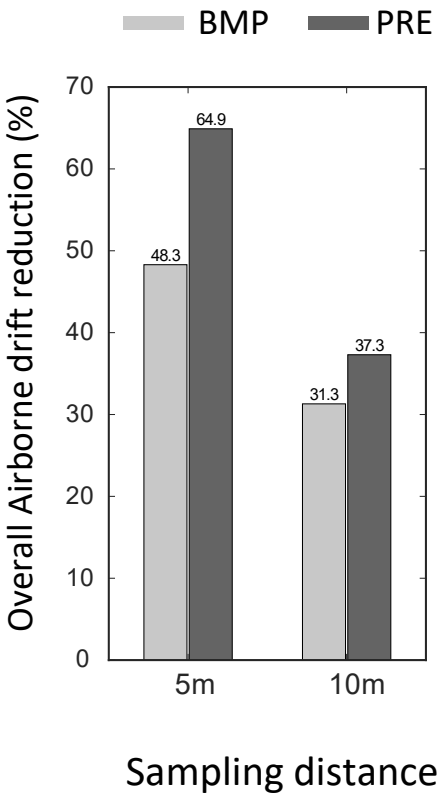
Airborne drift distribution at BBCH72





Airborne drift distribution at BBCH99





- Compared to the conventional application, the canopy-adapted applications can **reduce** the spray volume and dose: **a reduction of 12%** with the **optimized application** and **a higher reduction of 43%** with the **precise application**.

- There are **great difficulties** to fully **follow the ISO 22866** to quantify the spray drift because of the uncontrollable weather conditions.

- The **canopy-adapted applications** can **significantly reduce the ground drift** (23.3–70.9% reduction) at both growth stages BBCH 72 and 99 compared to the conventional application. The conventional axial-fan sprayer have a higher risk for ground drift, which may due to its poor target ability.

- The airborne drift can also be significantly mitigated using the canopy-adapted applications (26.2–84.6% reduction), and the **precision application** showed a **remarkable advantage** in drift reduction **for the sparse canopy** with low vegetation density.

Thanks for your attention