Reducing Glyphosate and AMPA losses from a non-tilled field using vegetative buffer strips

Laura Carretta[1], Alessandra Cardinali[1], Ester Marotta[2], Giuseppe Zanin[1], and Roberta Masin[1]

[1]Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE), University of Padua, Italy;

[2]Department of Chemical Sciences (DISC), University of Padua, Italy.

10th European Conference on Pesticides and Related Organic Micropollutants in the Environment
16th Symposium on Chemistry and Fate of Modern Pesticides
10th MGPR International Symposium of Pesticides in Food and the Environment in Mediterranean Countries

September 12-14, 2018 · Bologna (Italy)

laura.carretta.2@phd.unipd.it

Introduction

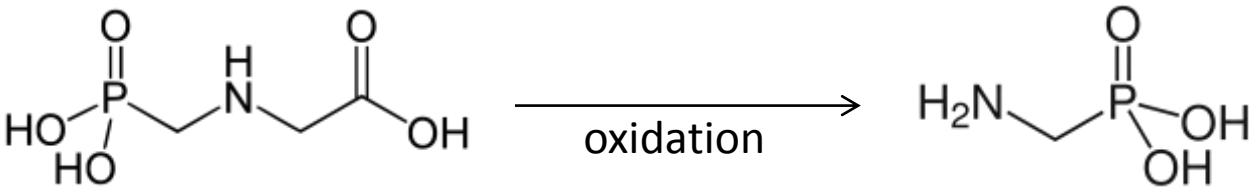
The transition phase from conventional to **conservation agriculture** is a critical period for:

- weed control → higher use of herbicides
- soil structure → increased surface runoff

↓

increased herbicide loss from the field to surface water

Introduction



GLYPHOSATE **AMPA**

- Globally most popular herbicide
- Moderately toxic to humans, birds, most aquatic organisms, earthworms and honeybees

- Major metabolite of glyphosate
- Similar properties and toxicity
- More persistent than glyphosate

		GLYPHOSATE	AMPA
DT_{50} soil	days	24	419
K_{oc}	mL/g	1424	2002
Solubility in water	g/L	10	1466

Source: PPDB. Pesticide Properties Database. https://sitem.herts.ac.uk/aeru/ppdb

Introduction

Vegetative buffer strips proved to effectively reduce herbicide runoff from cultivated fields mainly due to the ability of vegetation to delay surface runoff, promote infiltration and adsorb herbicides.

Common buffer strips in Po Valley (North-East Italy)

Aim of the work

This work aims to analyze the efficacy of a 6 m wide buffer strip compared with no-buffer plots in reducing **glyphosate** and **AMPA** runoff from a non-tilled soil in transition from conventional to conservation agriculture.

MITIGATION

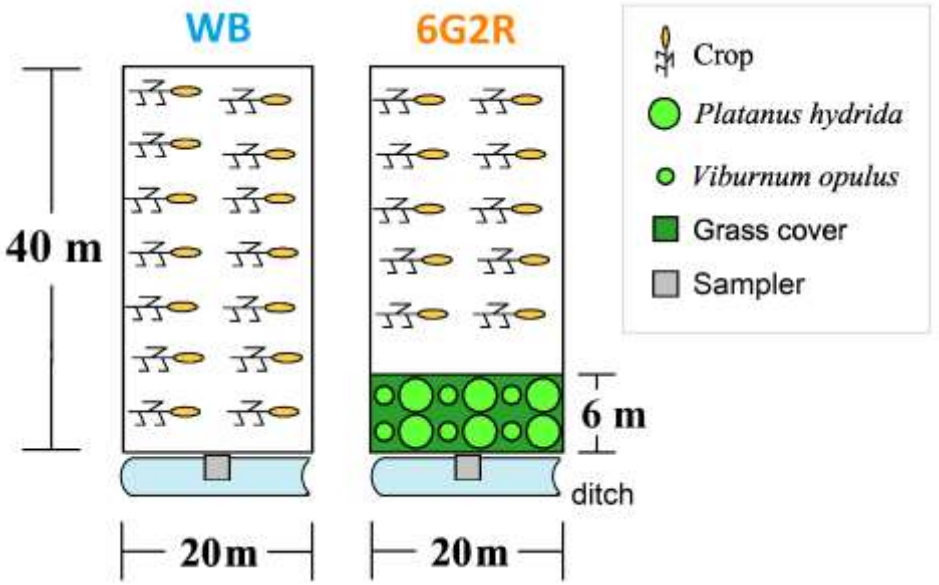
PSR Veneto 2014-2020

Materials and methods

A research programme in the Po Valley started in 1997 at Padova University Experimental Farm.

Two cases were compared:

- **WB**: without buffer
- **6G2R**: 6 m wide grass buffer with two rows of trees and shrubs



Actual cropping management
Natural rainfall

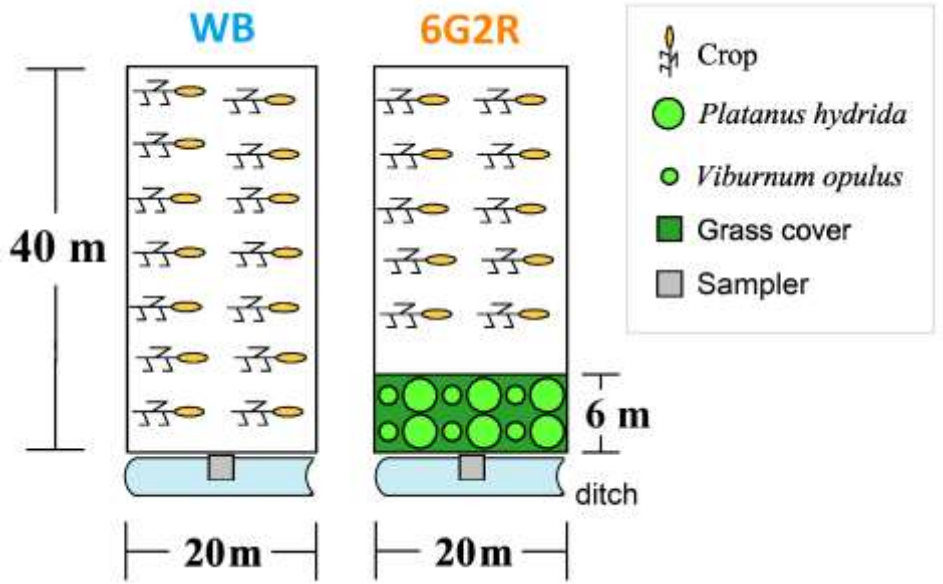
The ditch and the sampler

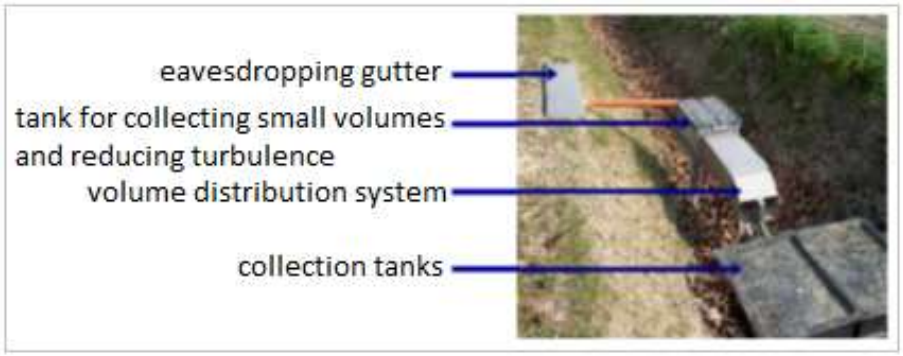
Materials and methods

A research programme was begun in 1997 in the Po Valley at Padova University Experimental Farm.

Two cases were compared:

- **WB**: without buffer
- **6G2R**: 6 m wide grass buffer with two rows of



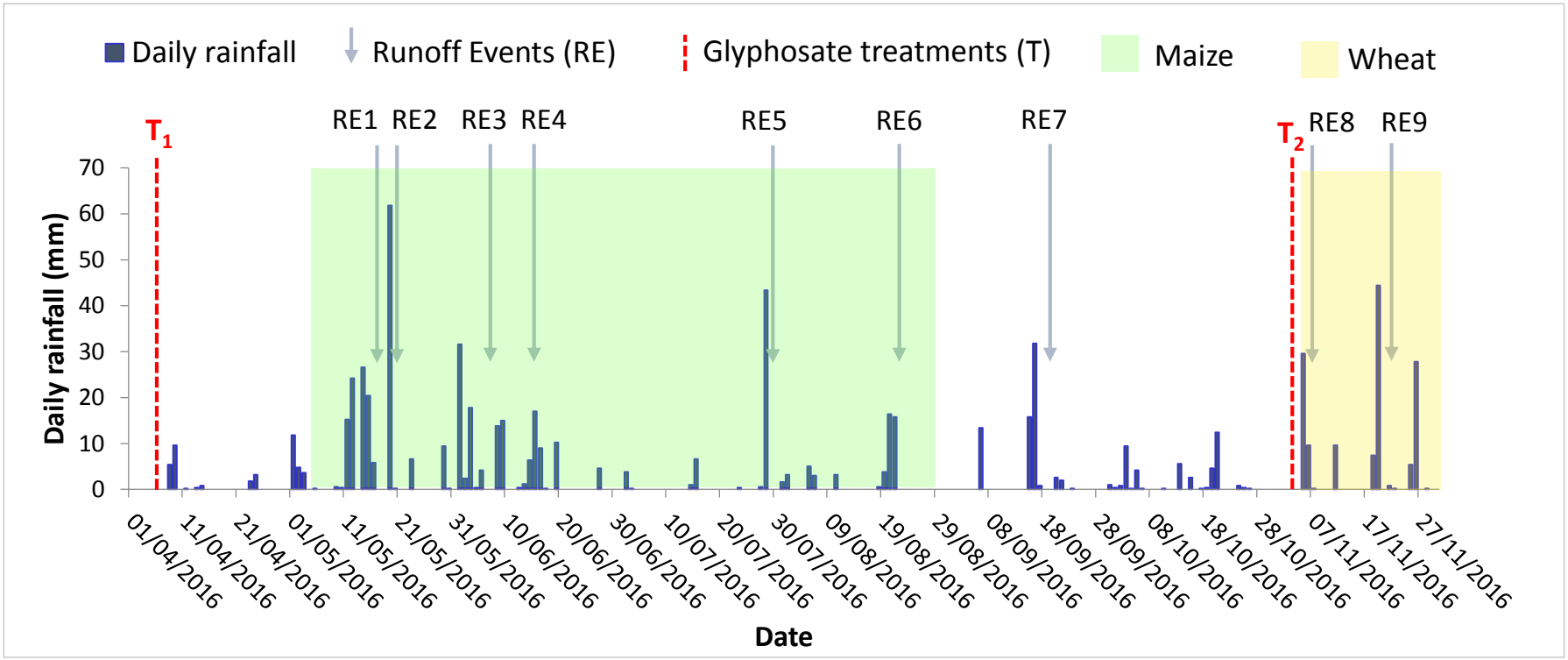


The ditch and the sampler

Materials and methods

Two glyphosate treatments were performed:

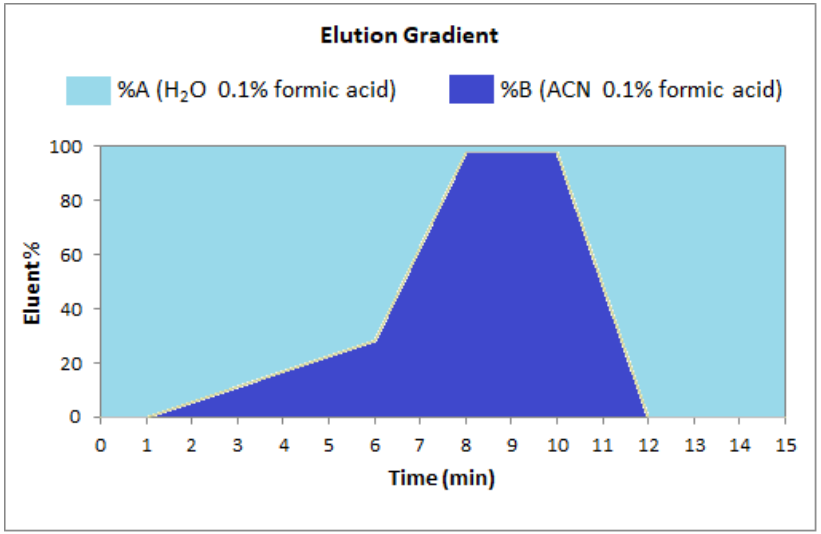
- 1st treatment (T_1): applied dose 1.08 kg/ha
- 2nd treatment (T_2): applied dose 1.44 kg/ha



Materials and methods

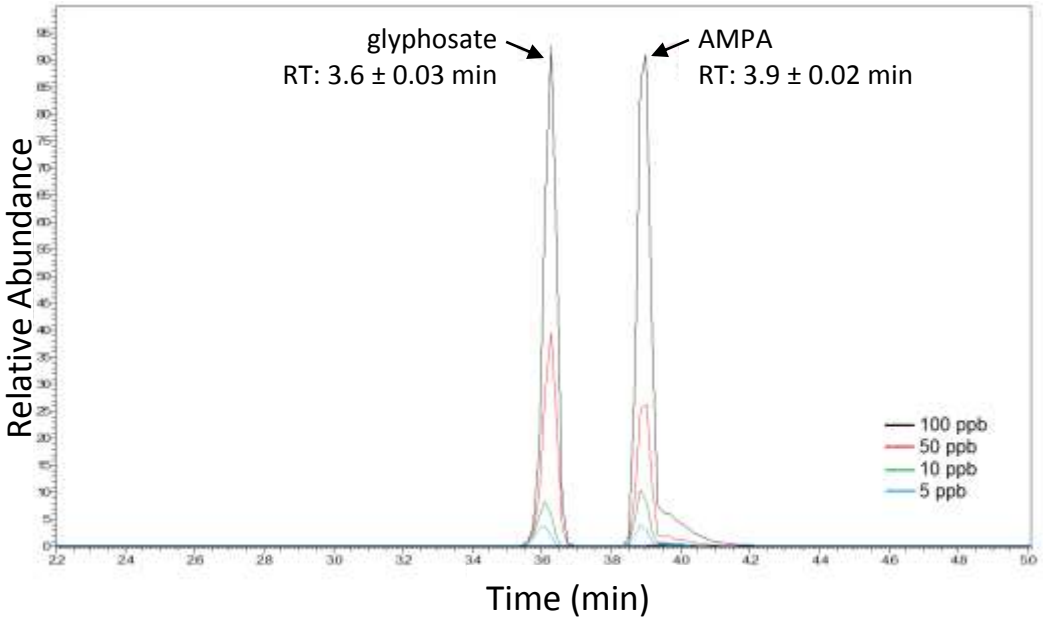
At every runoff event:

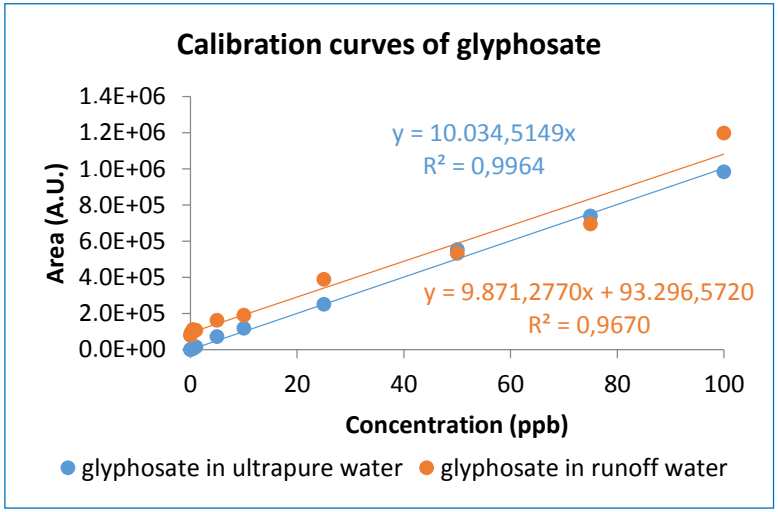
- measurement of runoff water volume
- analysis of glyphosate and AMPA concentration in runoff water

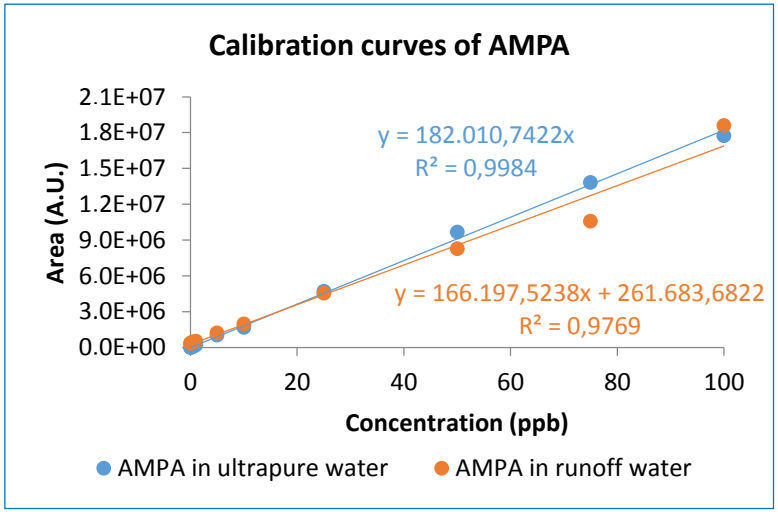


- Centrifugation and filtration
- Derivatization
- Analysis with LC-MS using triple quadrupole mass spectrometer with ESI source

Materials and methods







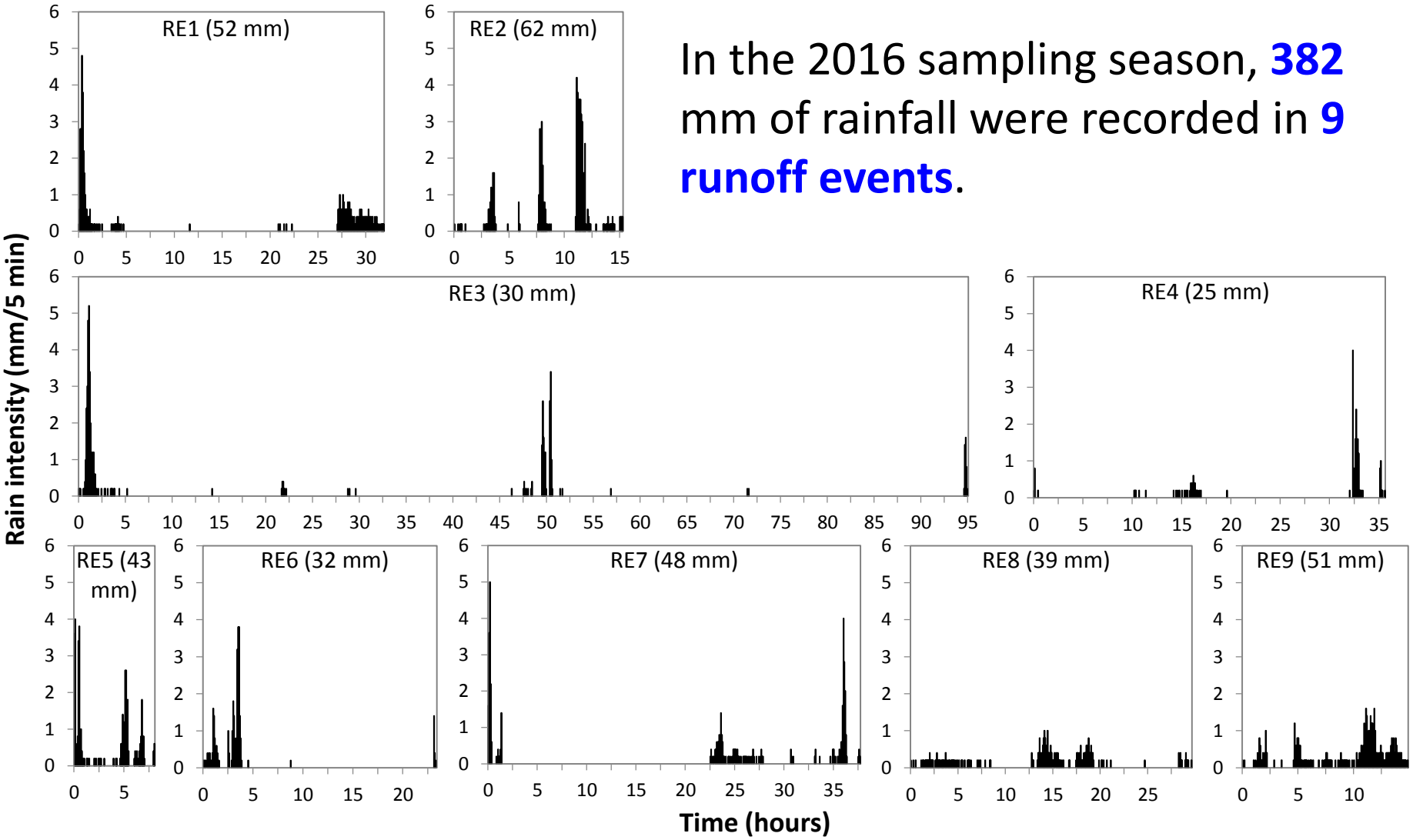
Recovery:

- Glyphosate: 98%
- AMPA: 91%

LOD: 0.05 µg/L

LOQ: 0.1 µg/L

Results

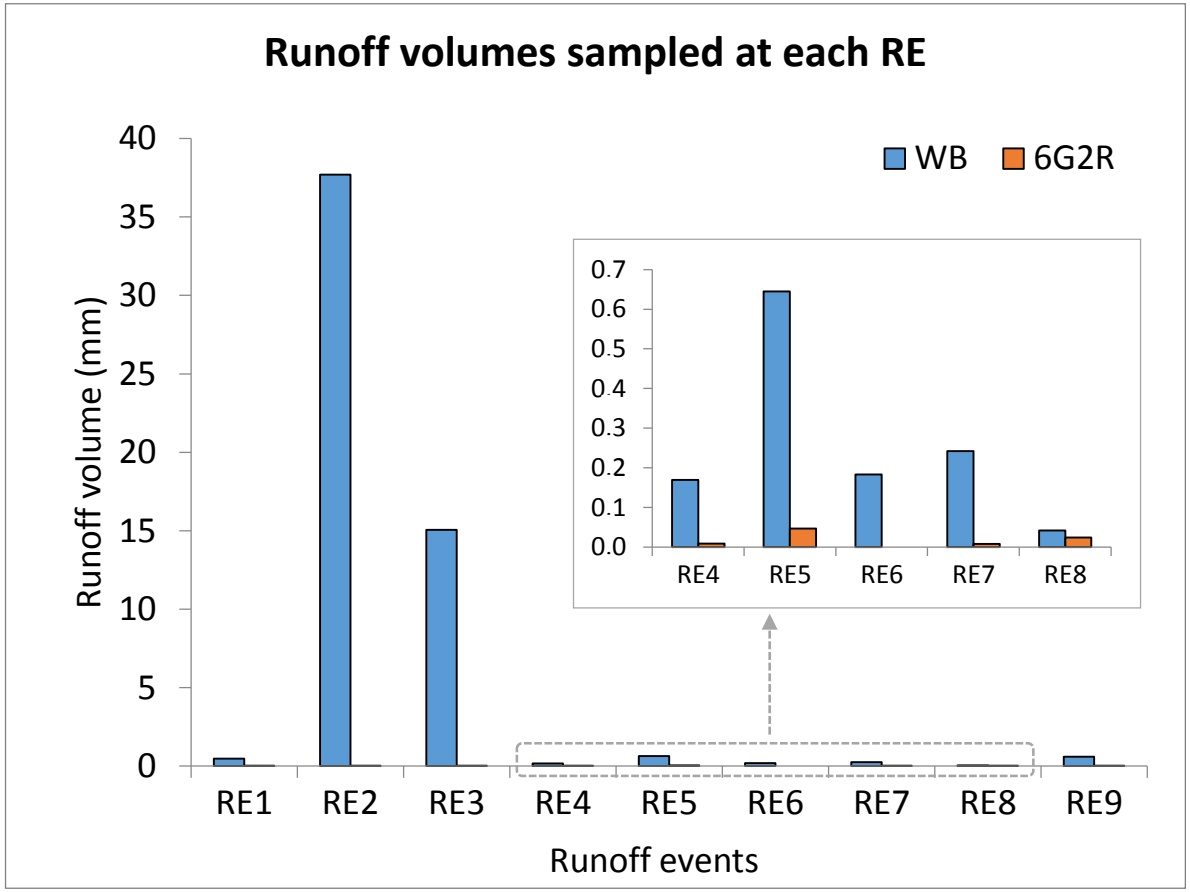


In the 2016 sampling season, **382** mm of rainfall were recorded in **9 runoff events**.

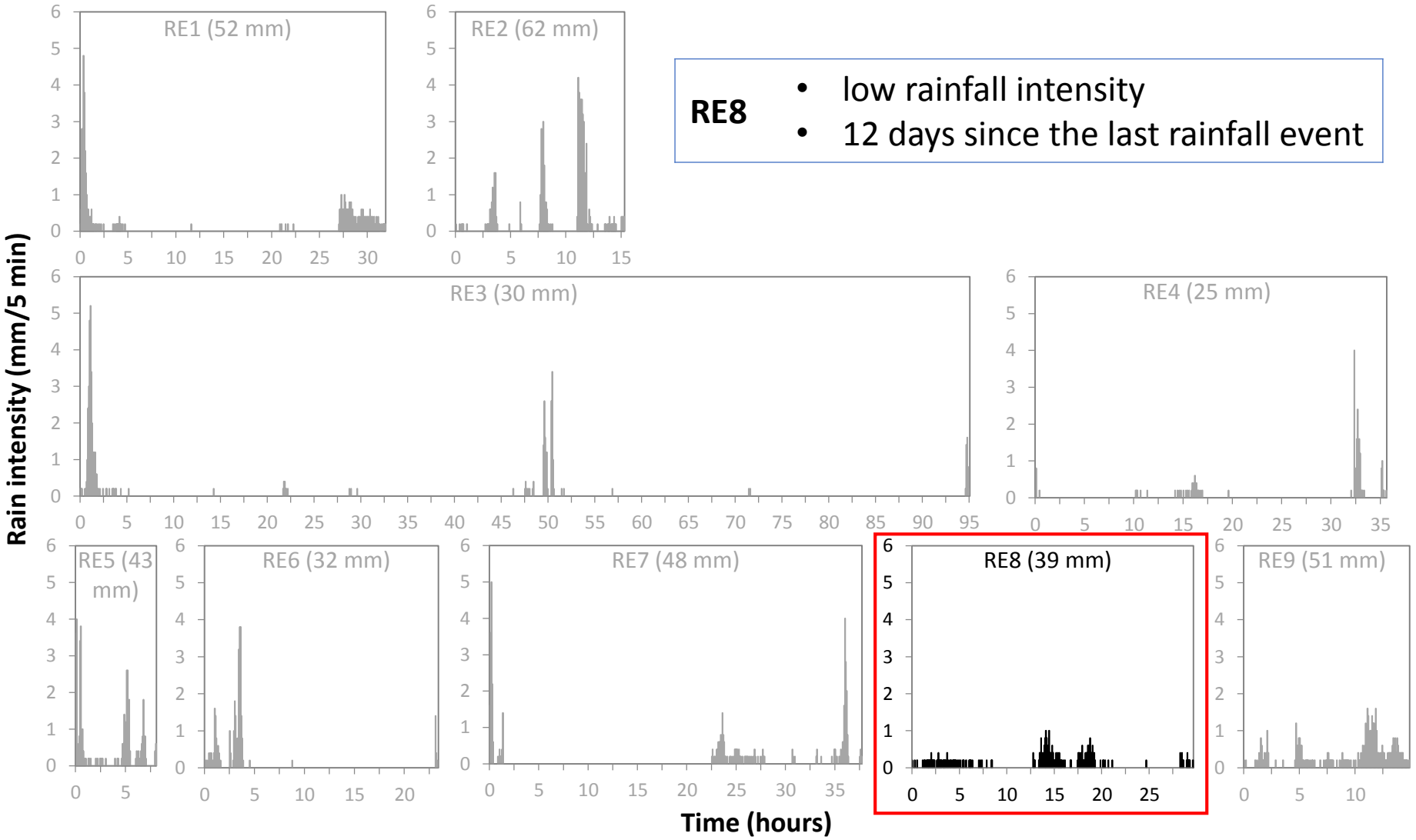
Results

Buffer strip effectively intercepted the runoff water.

Runoff volumes with the **6G2R** buffer were reduced by more than 92% in 8 out of 9 cases, compared to **WB** plots.



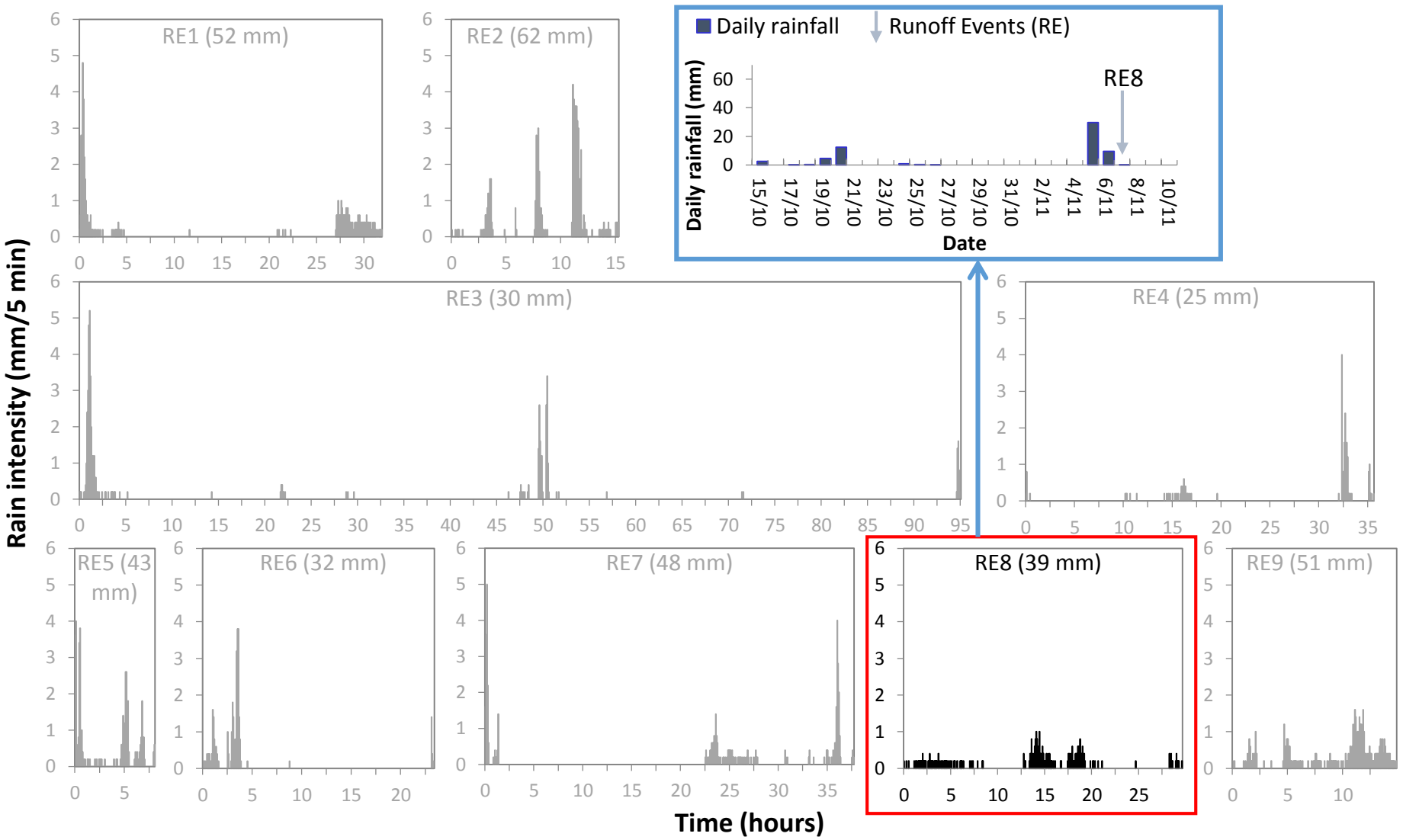
Results



RE8

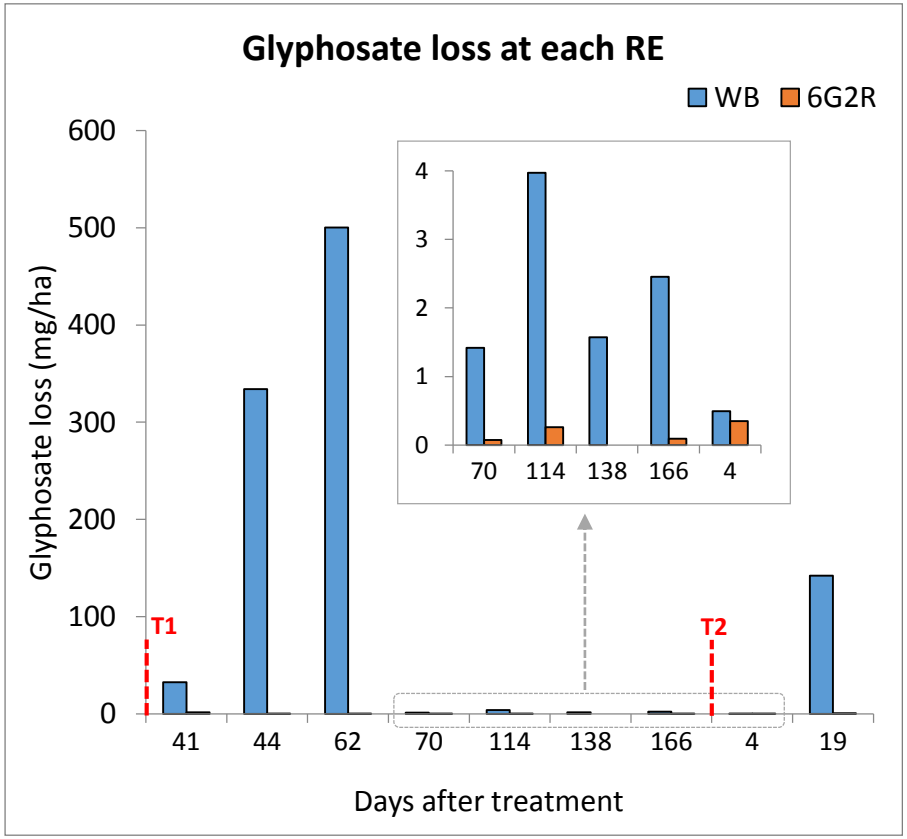
- low rainfall intensity
- 12 days since the last rainfall event

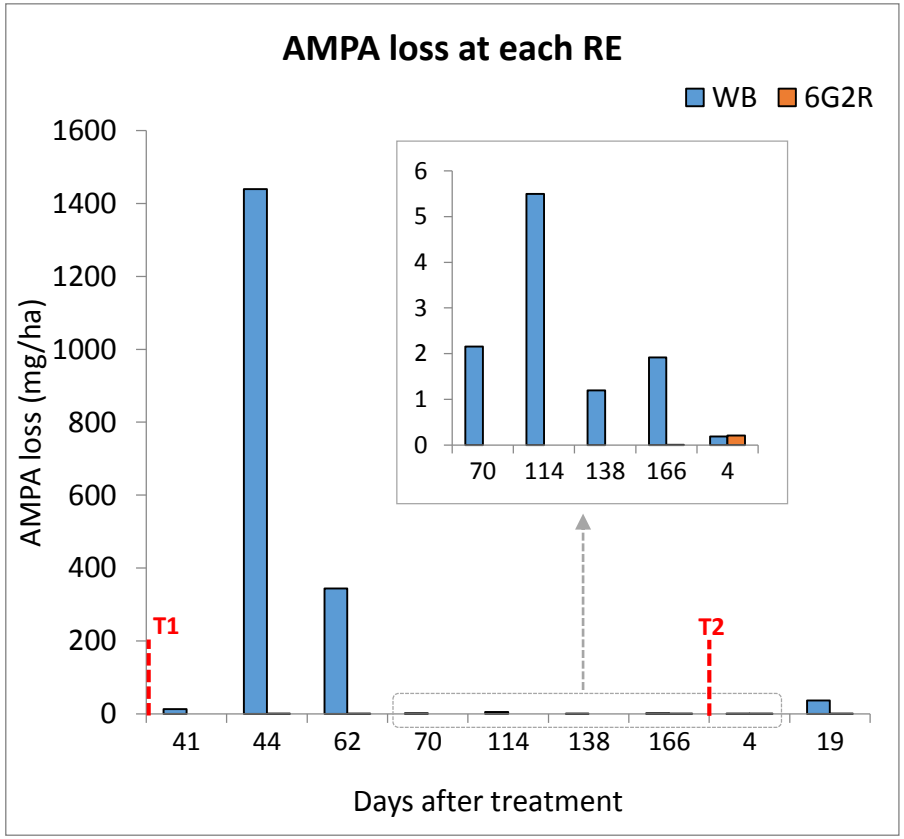
Results


Daily rainfall
Runoff Events (RE)
Daily rainfall (mm)
RE8
Date
15/10
17/10
19/10
21/10
23/10
25/10
27/10
29/10
31/10
2/11
4/11
6/11
8/11
10/11
RE1 (52 mm)
RE2 (62 mm)
RE3 (30 mm)
RE4 (25 mm)
RE5 (43 mm)
RE6 (32 mm)
RE7 (48 mm)
RE8 (39 mm)
RE9 (51 mm)
Rain intensity (mm/5 min)
Time (hours)

Results

6G2R buffer strip reduced glyphosate and AMPA total losses, with an average reduction of 90% for glyphosate and 87% for AMPA compared to **WB** plots:





Results

- Concentration range (µg/L) in runoff water:

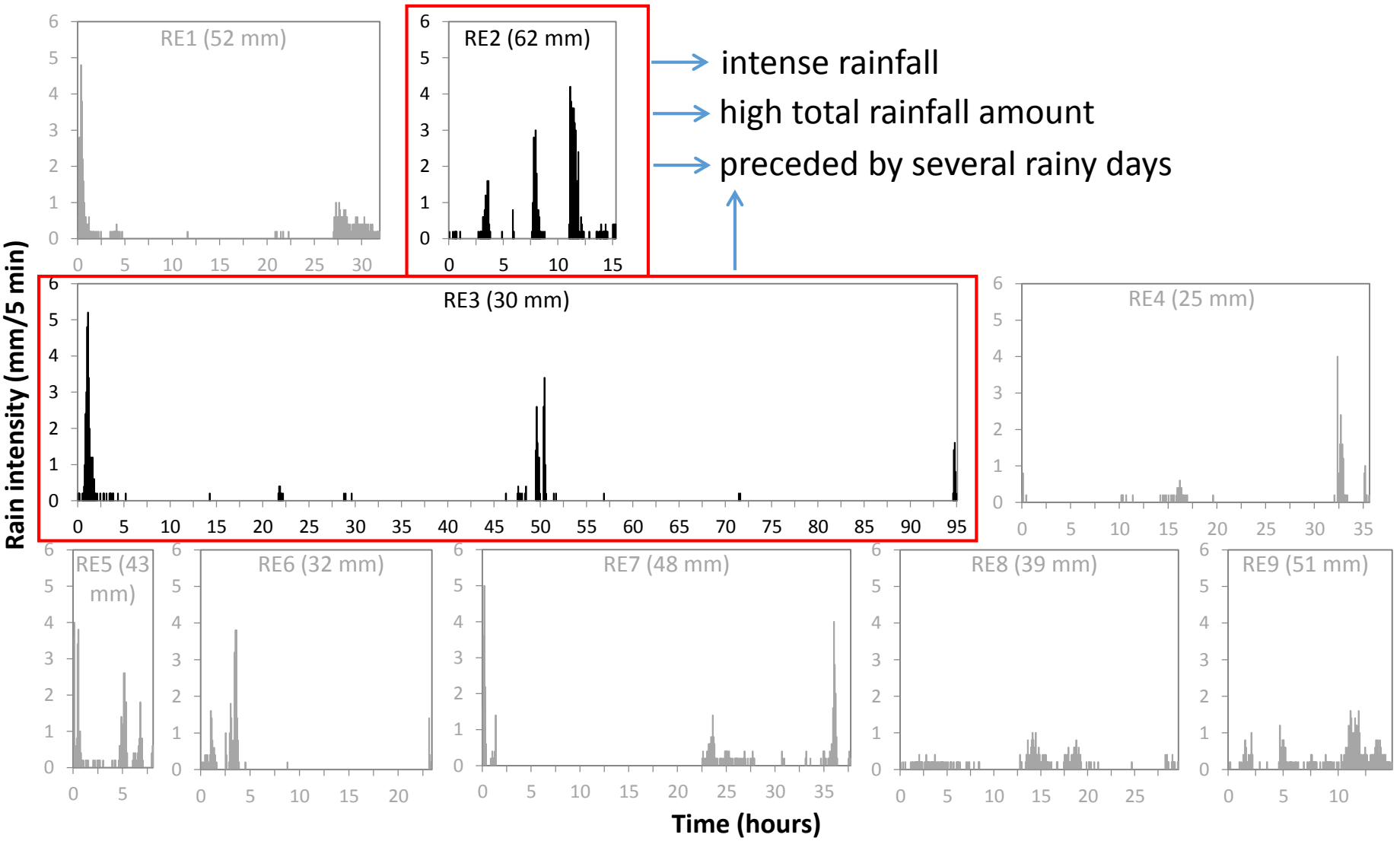
	WB		6G2R	
	Min	Max	Min	Max
Glyphosate	0.57	24.57	0.43	12.69
AMPA	0.40	6.99	0.30	4.83

Glyphosate and AMPA concentrations never exceeded the ecotoxicological endpoints for fish and algae.

- AMPA losses > glyphosate losses (from **WB** plots): AMPA is more persistent than glyphosate → possible accumulation in the soil from previous treatments.

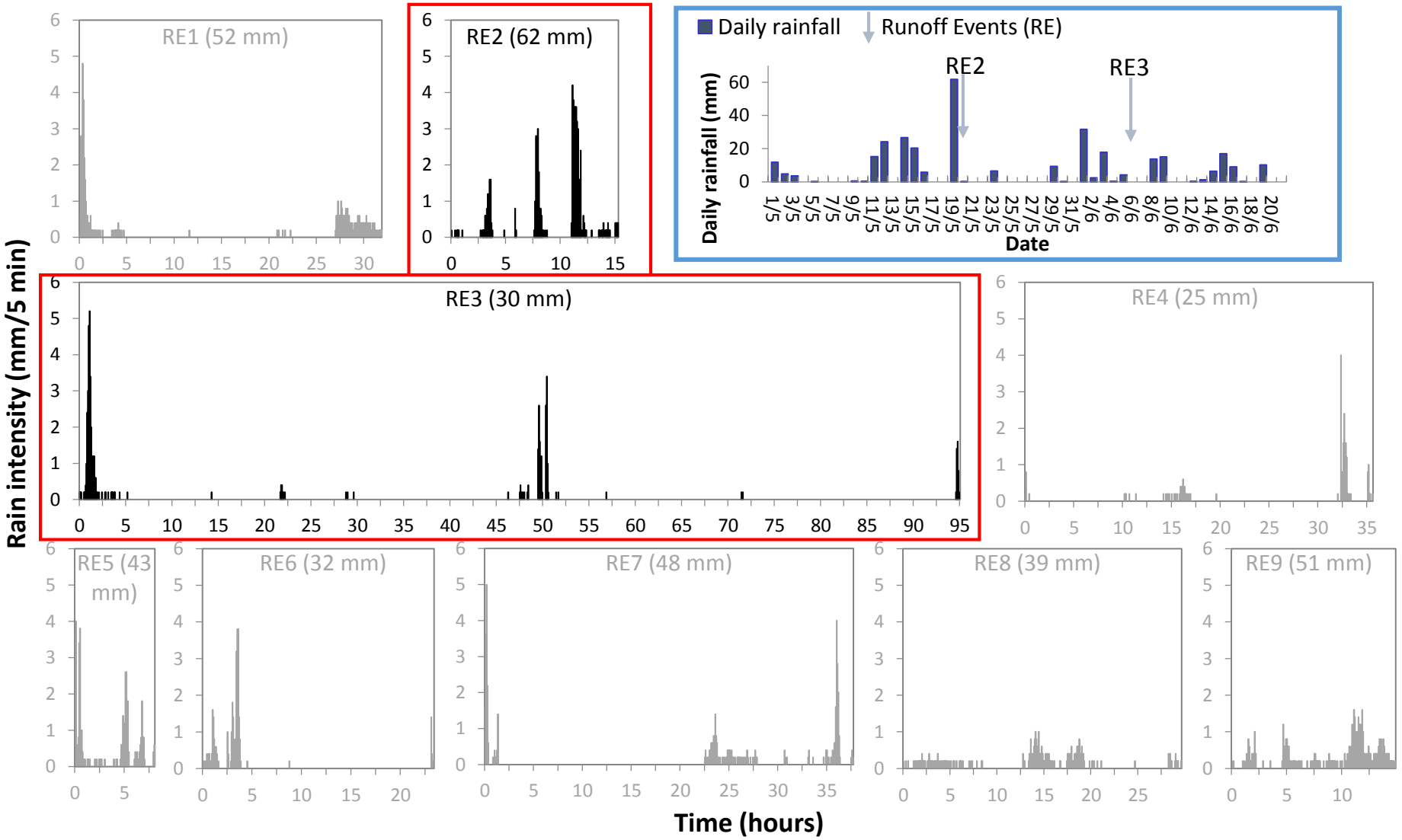
- Larger runoff volumes and higher losses of glyphosate and AMPA were from **WB** plots at RE2 and RE3.

Results



- intense rainfall
- high total rainfall amount
- preceded by several rainy days

Results


RE1 (52 mm)
RE2 (62 mm)
Daily rainfall
Runoff Events (RE)
RE2
RE3
Daily rainfall (mm)
Date
RE3 (30 mm)
RE4 (25 mm)
RE5 (43 mm)
RE6 (32 mm)
RE7 (48 mm)
RE8 (39 mm)
RE9 (51 mm)
Rain intensity (mm/5 min)
Time (hours)

Conclusions

- In the transition phase from conventional to conservation agriculture, an increase in surface runoff may occur.
- Buffer strip reduced runoff volumes and mitigated glyphosate and AMPA transfer to surface water (**87-90%** reduction).
- This study, with **9** runoff events, confirms that a **6 m wide buffer strip with two rows of trees and shrubs** is a very effective mitigation system against runoff, even in agronomic situations that promote runoff.

Reduced impacts of herbicides on human health and aquatic life.


Thanks for your attention