

# Combining chemical and mechanical weeding in wheat

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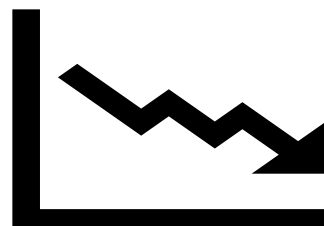
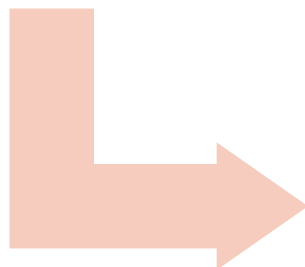
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Agro-Bio Tech

# Context

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- Soft wheat is one of the most import crop in Europe with 131,04kT for an area of 21,69kha in 2021 (eurostat, 2022)
- In Belgium wheat is the most cultivated crop with 20% of arable crop land in 2021.(statbel,2021)



- European Union aims at reducing by 50% the use of phytopharmaceutical products by 2030 (EU Directive 2009/128/EC)



Adapt weed management strategies in soft wheat

# Experimental setup

- Data collection over 4 seasons :
  - 2018-19
  - 2019-20
  - 2020-21
  - 2021-22 (in progress)
- Split plot design
- Four replicates
- /!\ No combination of dicot-weeds with grass-weeds

**Mechanical weeding:  
harrow and rotary hoe**

**Control:**  
0 pass

**1 pass harrow:**  
Tillering stages(T)

**2 passes harrow:**  
T+ stem extension(SE)

**1 pass rotary hoe:**  
T

**1 pass rotary hoe+ 2 passes  
harrow**  
T (rotary hoe +harrow)+  
SE(harrow)



**Chemical weeding:**

**Dicot-weeds:  
Biathlon duo**  
(5.4 % florasulam  
71.4 % tritosulfuron )  
(70g/ha full dose)

**Grass-weeds:  
Axial**  
(12.5 g/l cloquintocet-  
mexyl  
50 g/l pinoxaden )  
(1,2L/ha full dose)

**0 herbicide**

**Half dose**

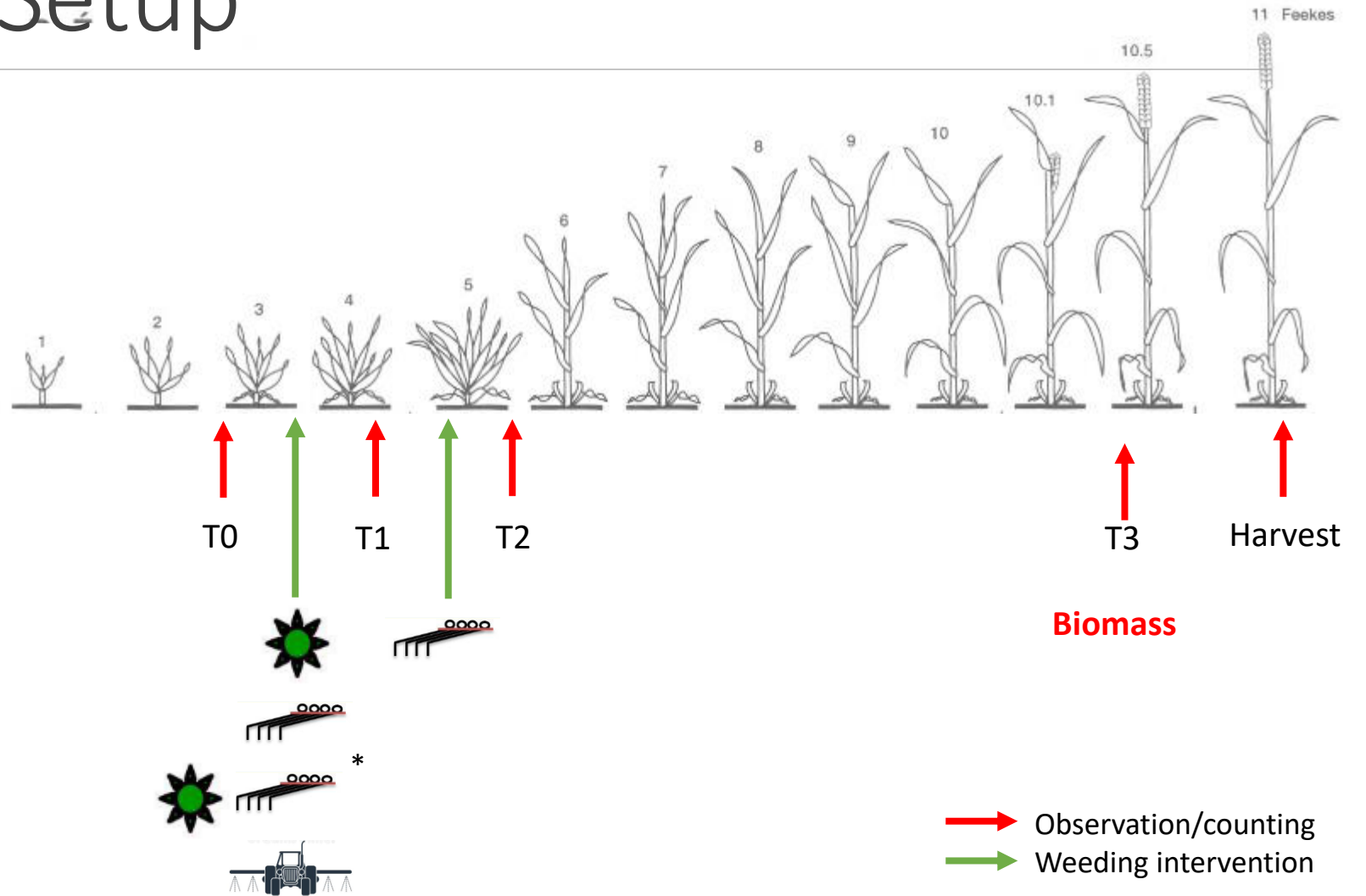
**Full dose**

**Example with  
2020-21 protocol**

# Experimental Setup



50cm x 50cm quadrat



$$\text{Weeds reduction} = \frac{\text{Weeds}_{Tn} - \text{Weeds}_{T0}}{\text{Weeds}_{T0}} * 100$$

\*Pass of harrow was performed the day after the rotary hoe

# Experimental Setup

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**Harrow**



**Rotary hoe**

# Overview

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Effect of mechanical weeding combining with dicot-weeds

Impact on yield

 **Focus on dicot populations** [Grass populations only present in year 1]

# Overview

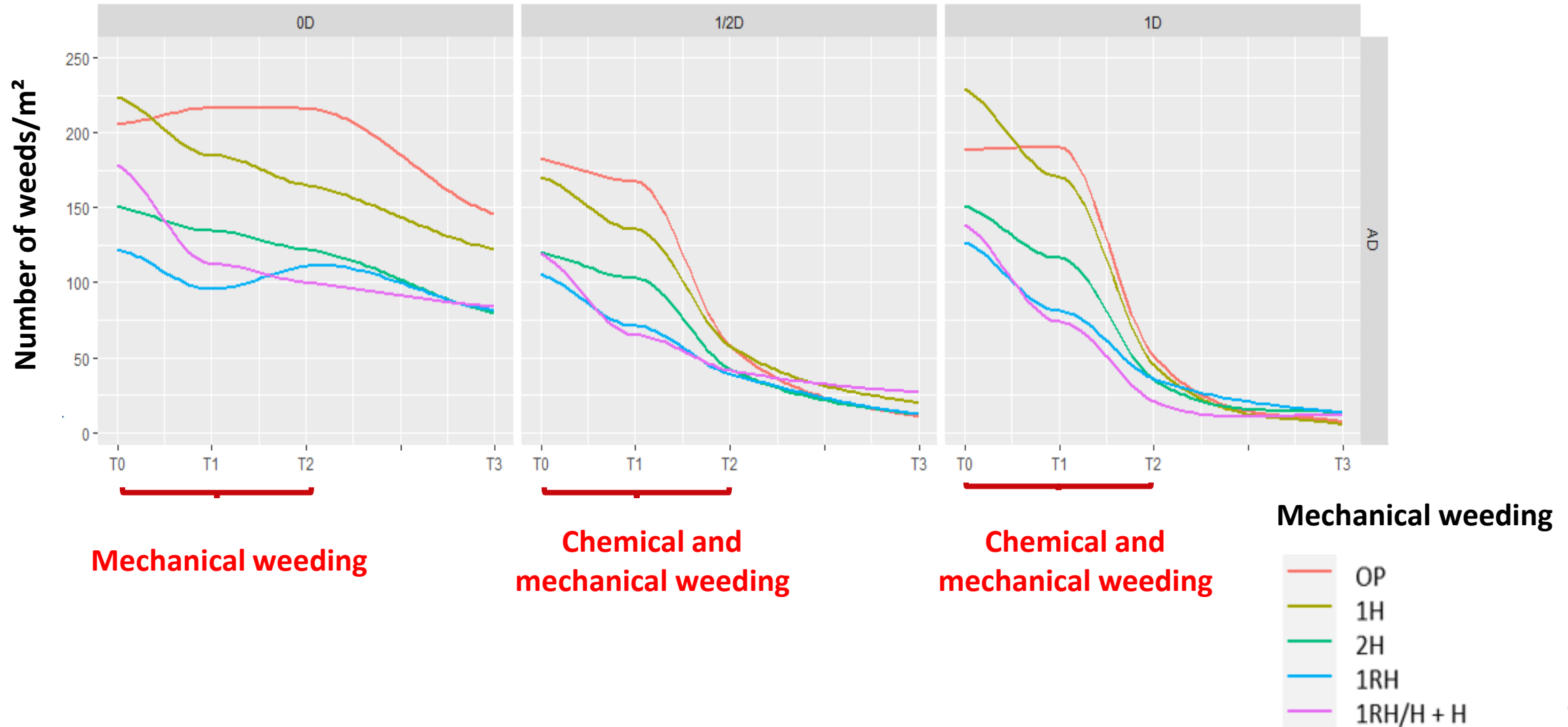
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**Effect of mechanical weeding combining with dicot-weeds**

**Impact on yield**

# Effect of mechanical weeding combining with dicot-weeds

Fitted trend on observations

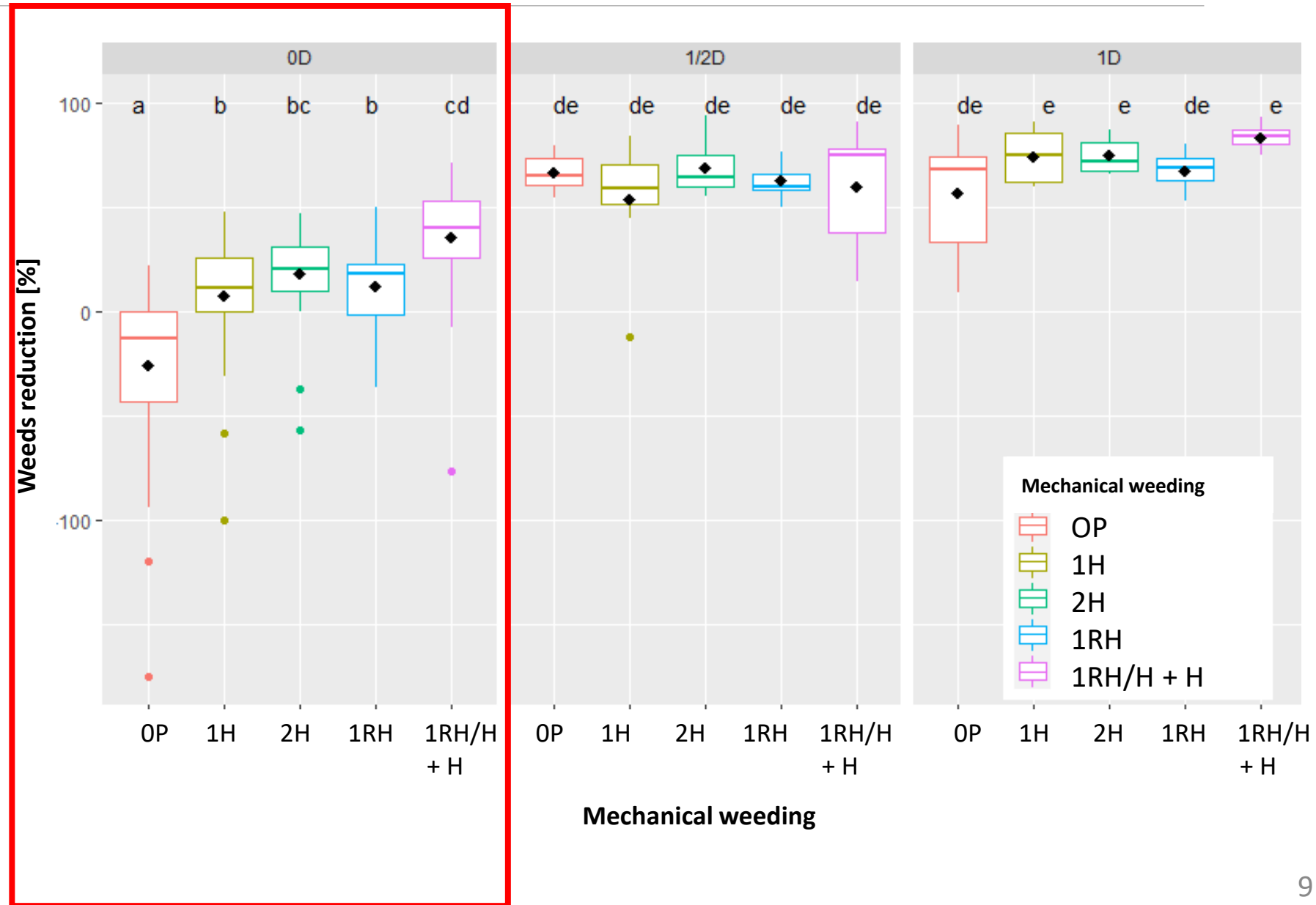




# Effect of mechanical weeding combining with dicot-weeds

## Without herbicide:

- Combining rotary hoe and harrow has the best impacts on weed reduction
- 2 passes of harrow has the second best impact on weed reduction



# Effect of mechanical weeding combining with dicot-weeds

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- Preferential path tend to appear on threshing soil conditions
- Reduction of the harrow efficiency : teeth tend to fall into the path drawn by first tooth.

➔ Suggest an interest of using a rotary hoe at the end of winter

**Illustration of preferential path**



➔ **Addition of treatment with rotary hoe in the trial (years 3 and 4)**

# Effect of mechanical weeding combining with dicot-weeds

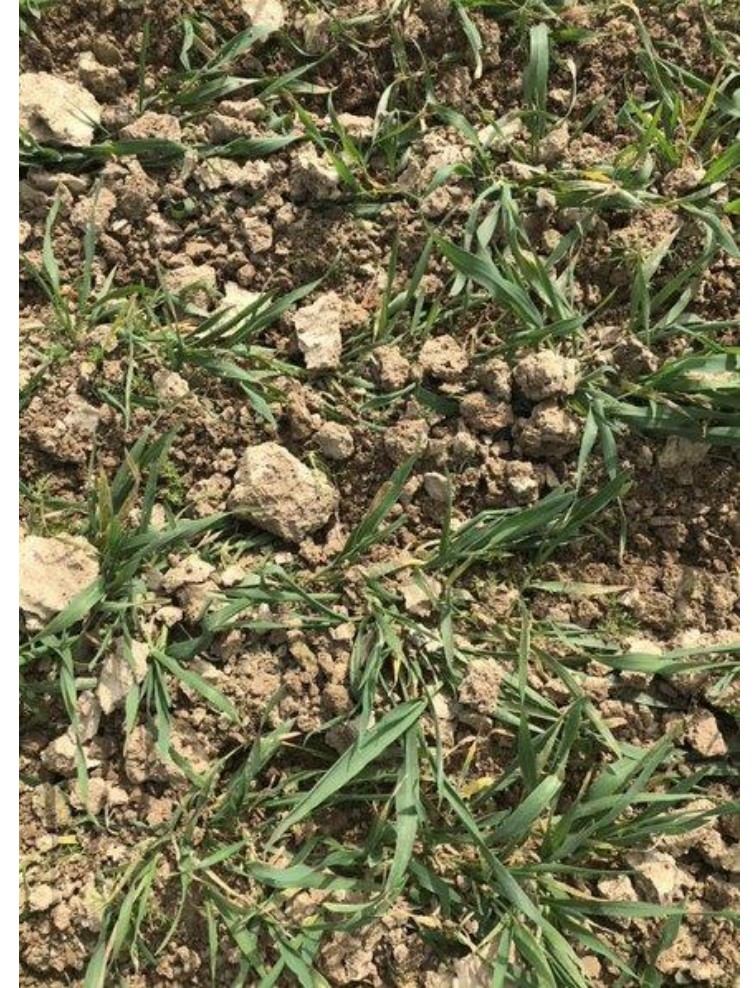
Harrow



Rotary hoe



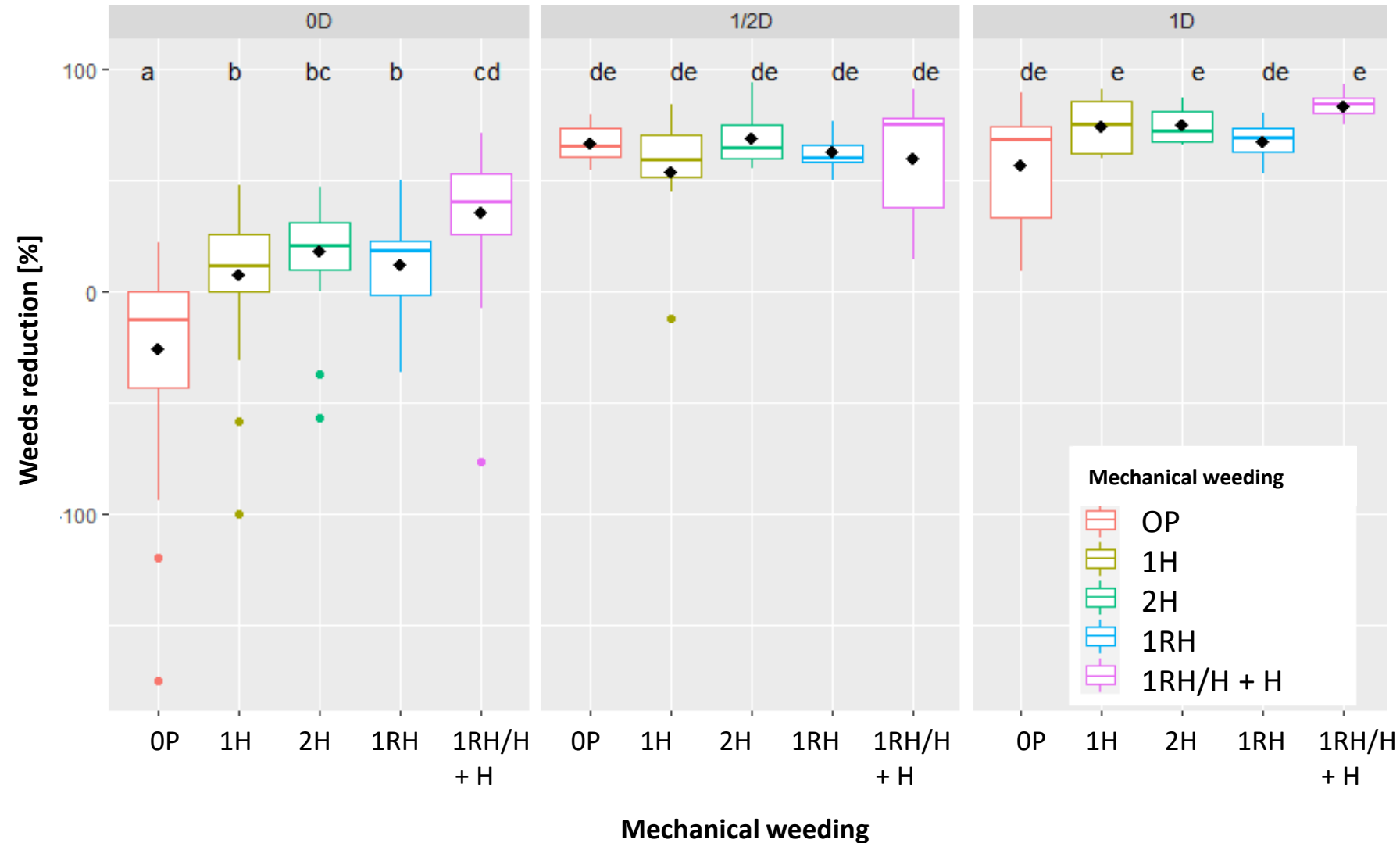
Rotary hoe + harrow



# Effect of mechanical weeding combining with dicot-weeds

## With herbicide:

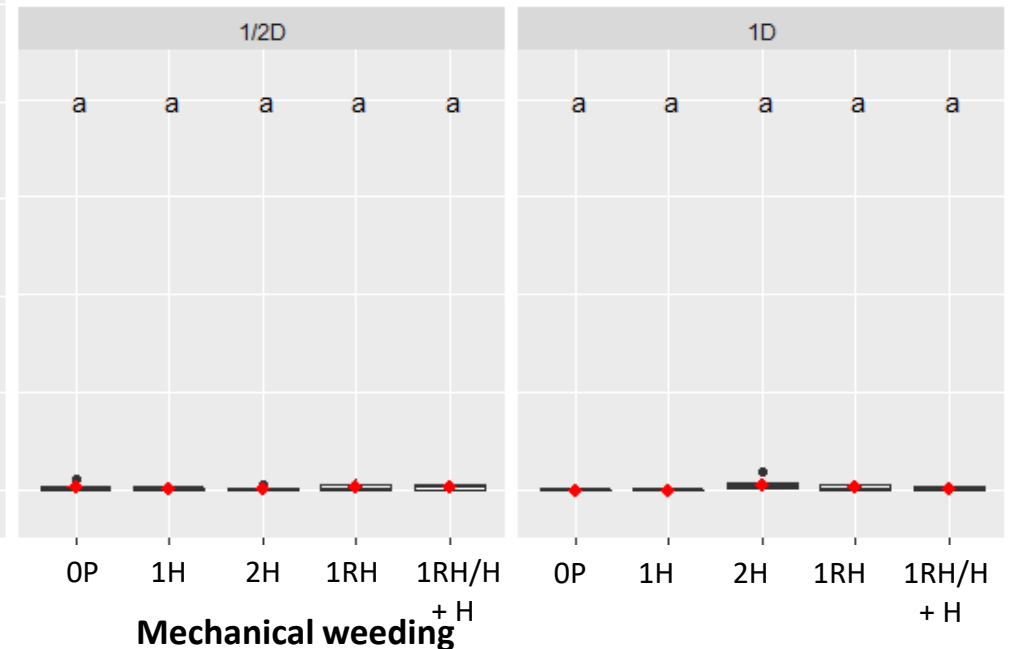
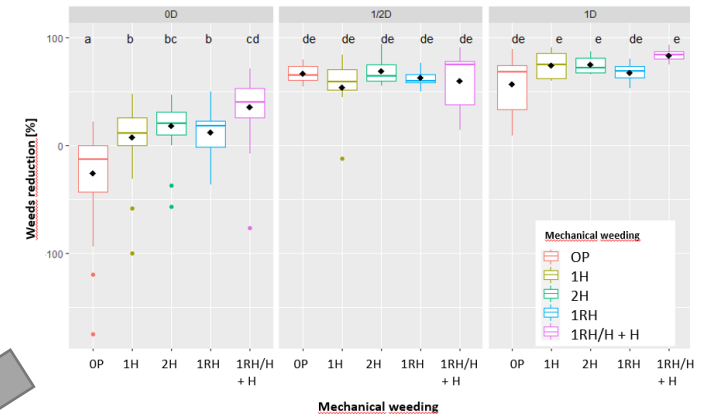
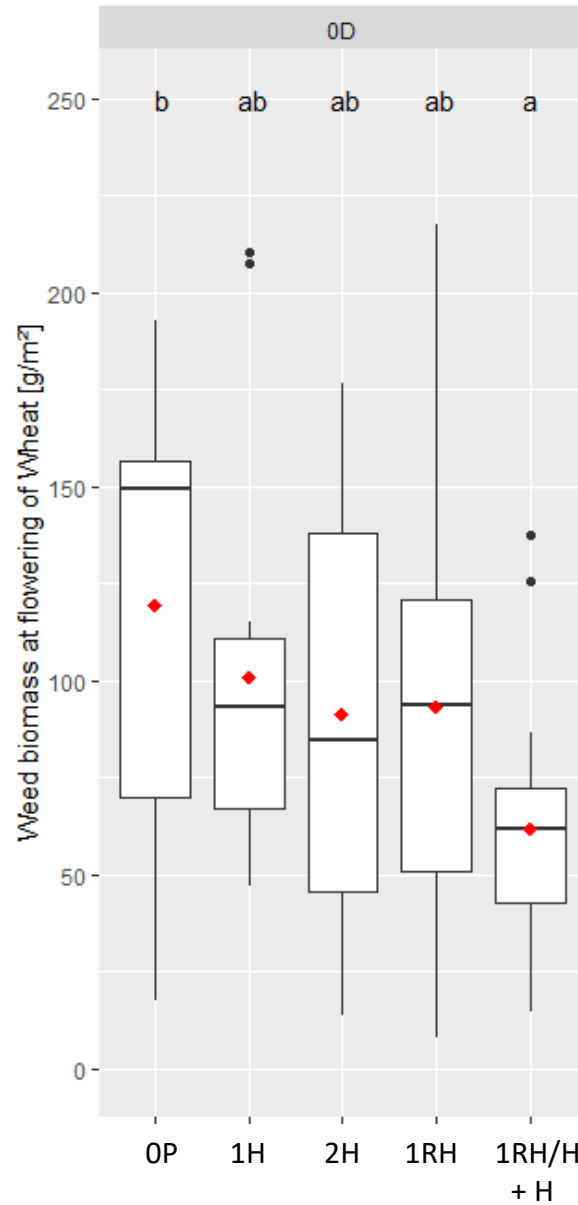
- Good response to chemical weeding application, starting ½ dose
- No statistical ranking of mechanical weeding techniques when chemicals are applied



# Effect of mechanical weeding combining with dicot-weeds

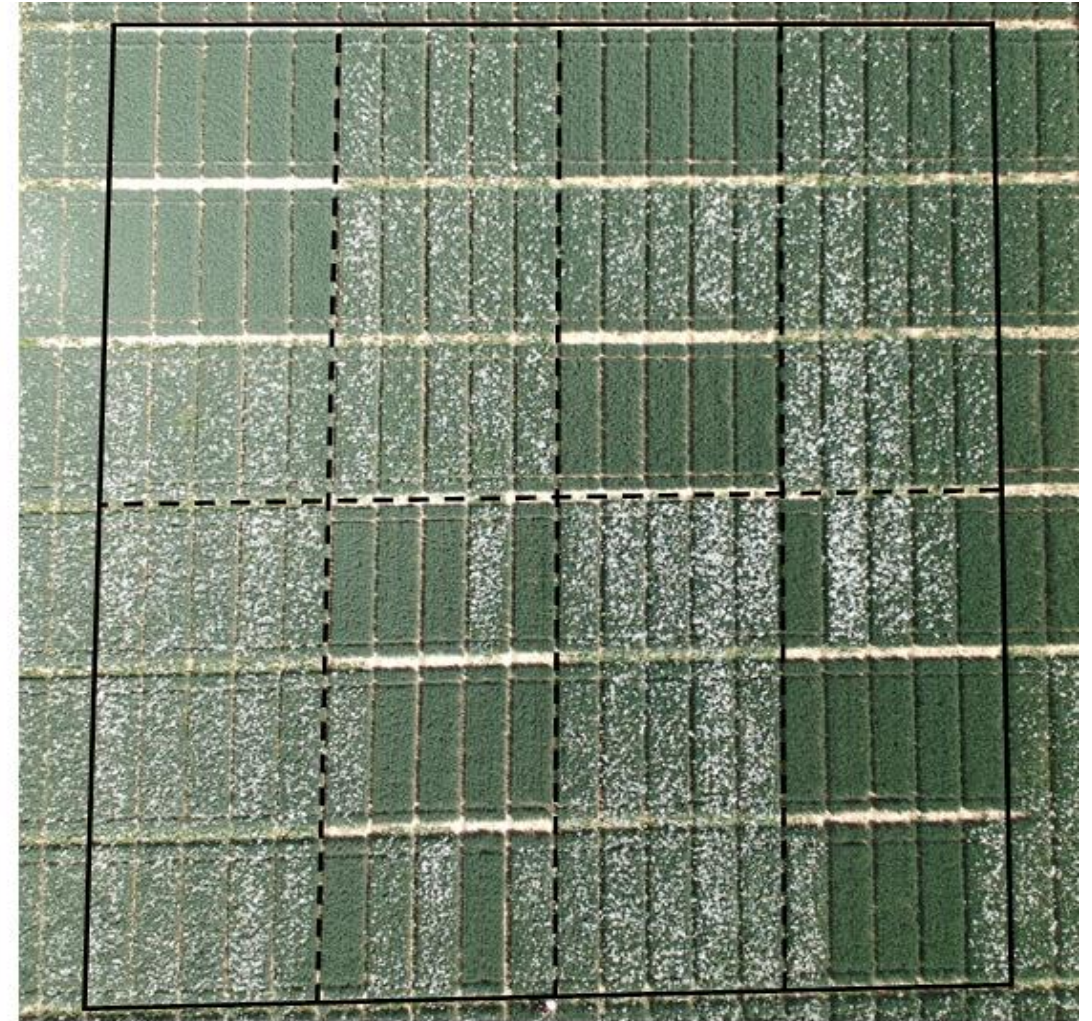
## Looking at weed biomass :

- With herbicide application, the weed biomass is nearly null
- Under sole mechanical weeding, the weed biomass is the lowest under RH/H + H (statistically different from control plot (OP+0D))



# Effect of mechanical weeding combining with dicot-weeds

Confirmed with drone imagery\*



Harrow	0	1x	2x	0	2x	0	2x	0	1x	2x	2x	0	2x	0	1x	1x	0	2x	2x	0
Rotary hoe	0	0	0	1x	1x	1x	0	0	0	1x	1x	1x	0	0	0	0	0	0	1x	1x

\* The authors are thankful to *Matricaria chamomilla* for providing flowers to support this statement ;-)

# Overview

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Effect of mechanical weeding combining with dicot-weeds

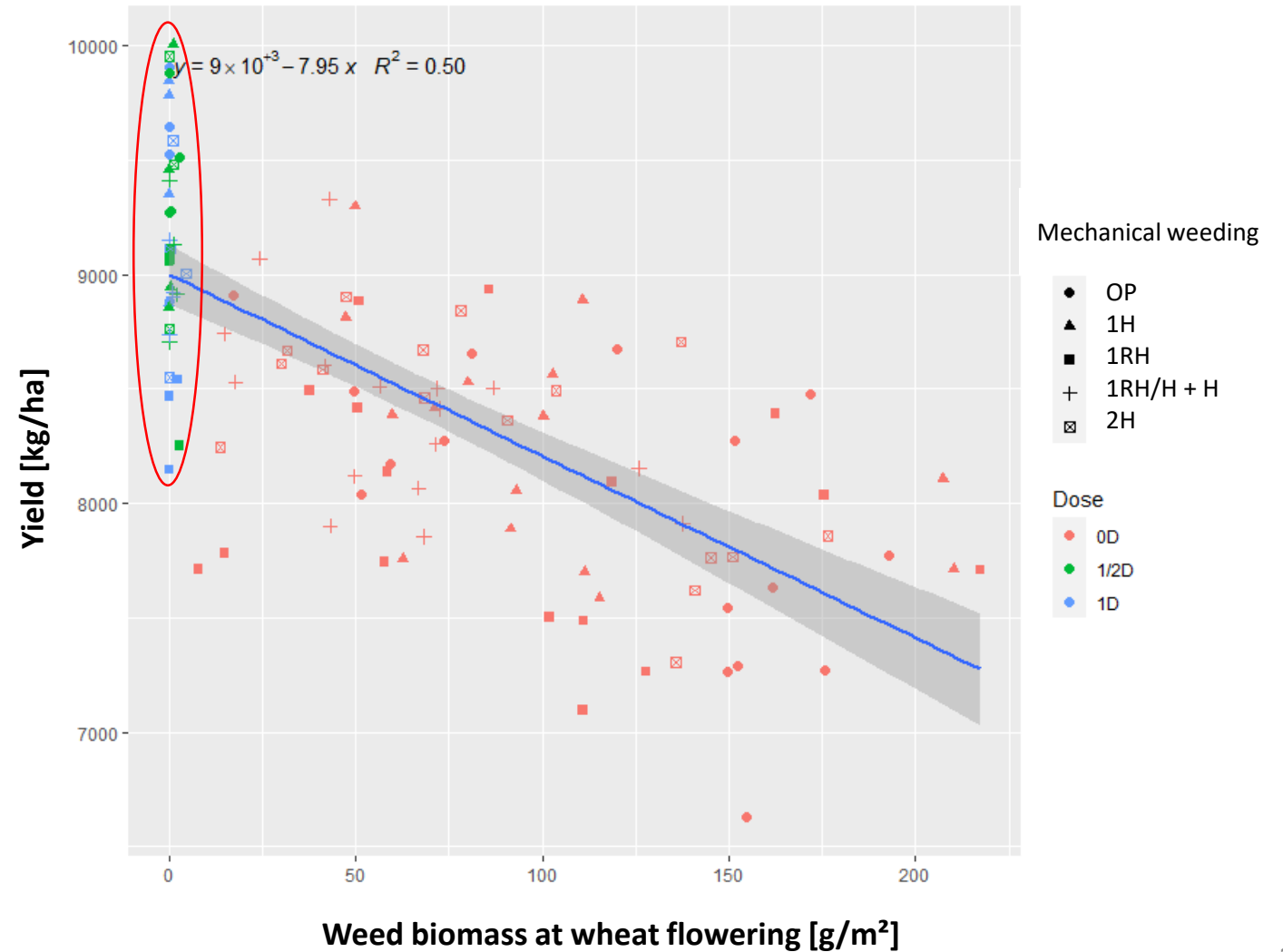
Impact on yield

# Effect of mechanical weeding combining with dicot-weeds

➤ Dicot-herbicide treatments exhibited the highest performances in terms of yield (○ - red circle)

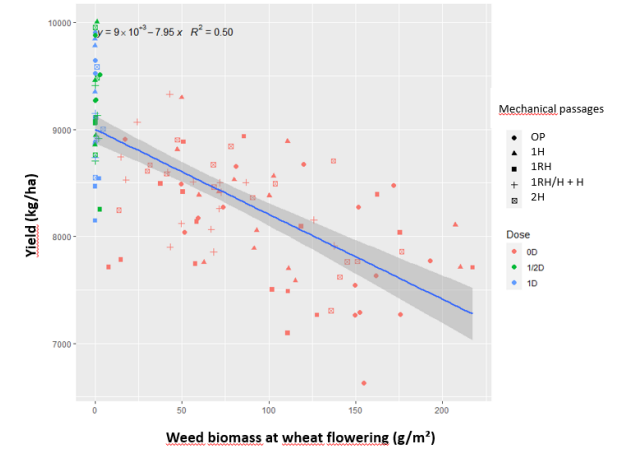
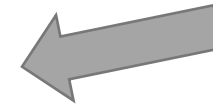
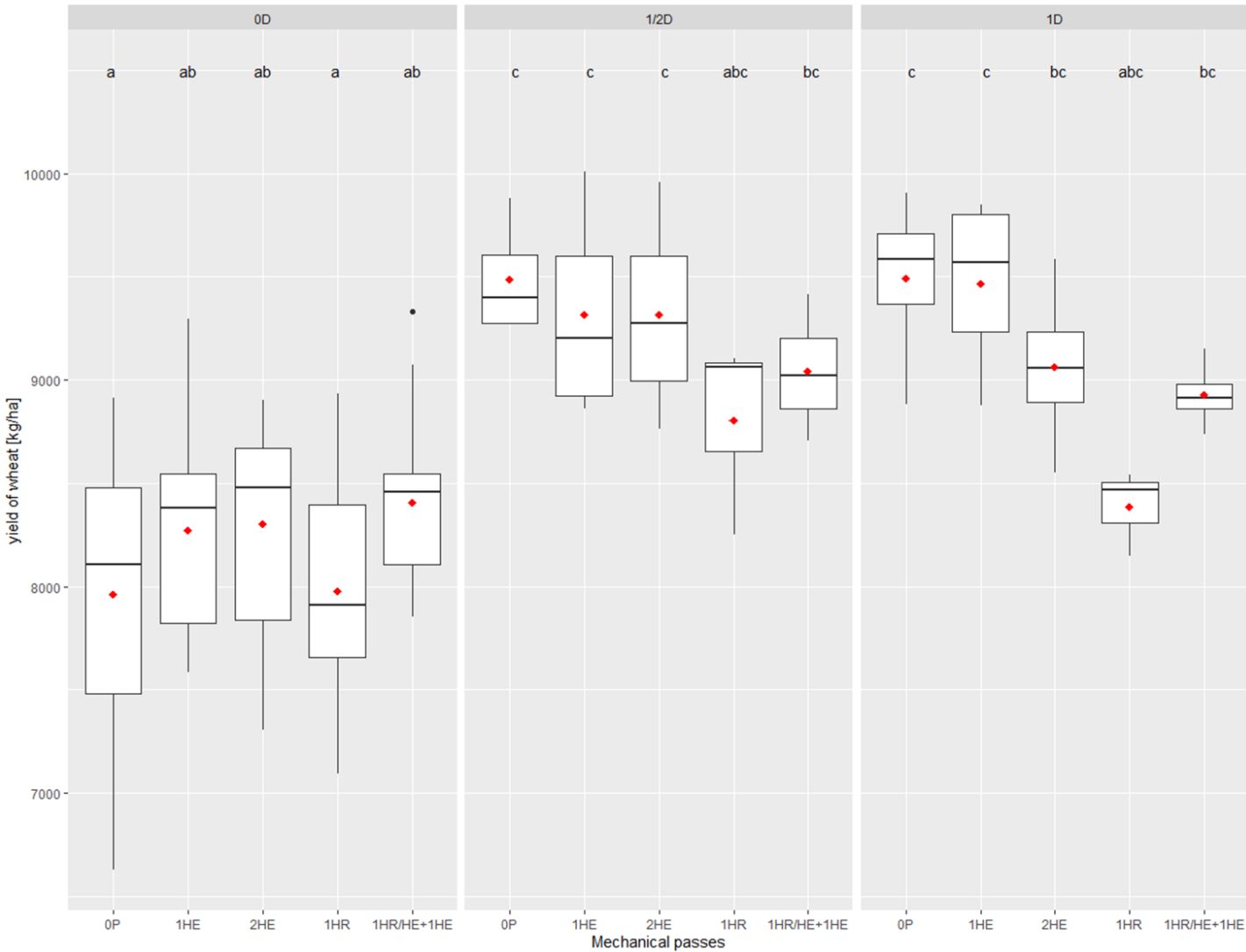
➤ Yield decline appeared to be proportionnal to the biomass of weeds (--- - Blue line)

But...



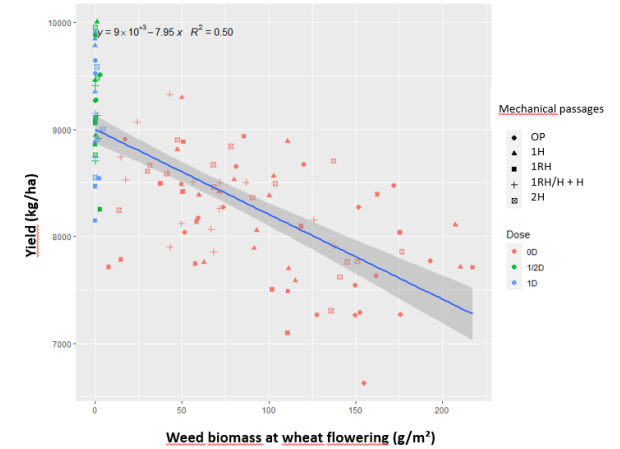
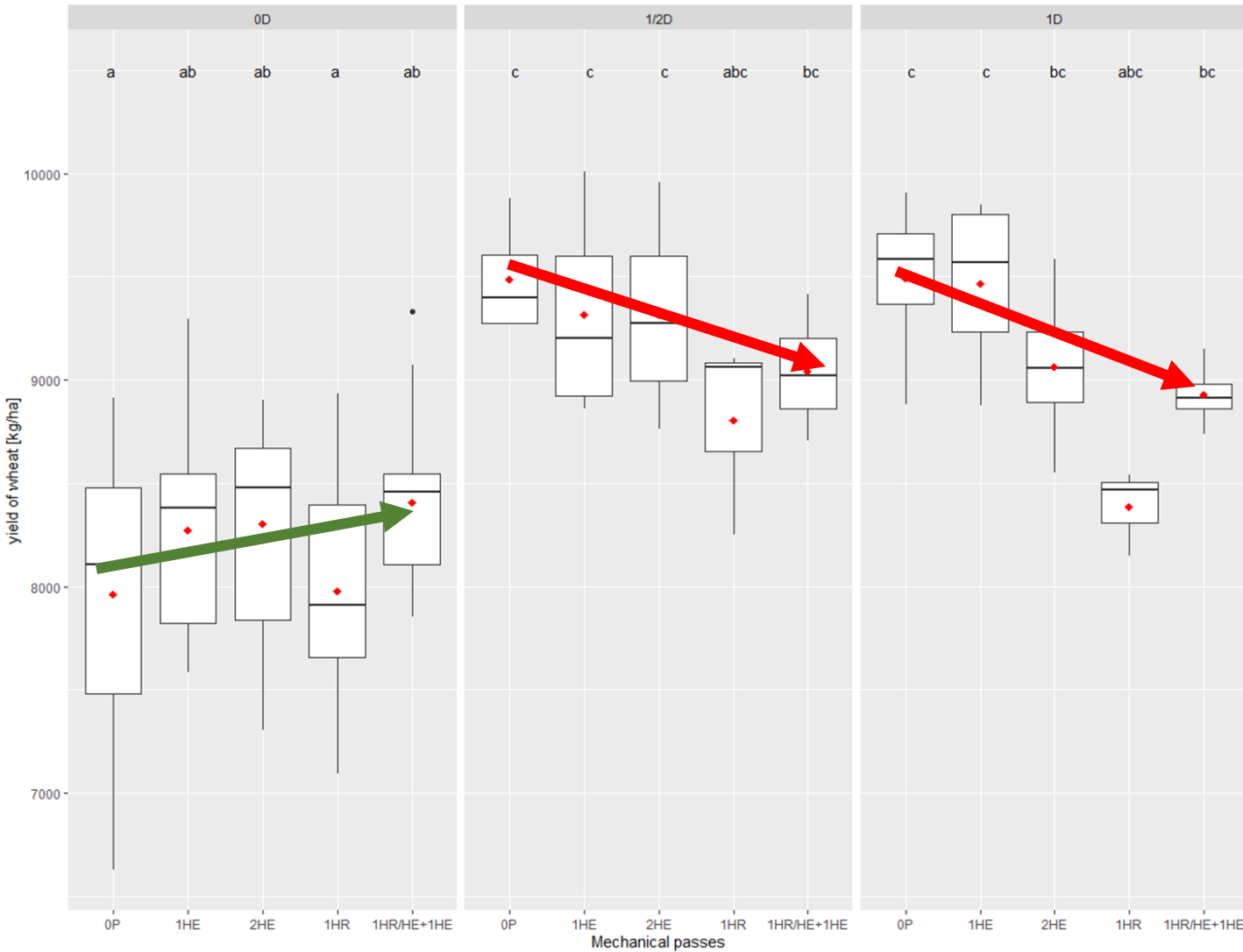


# Effect of mechanical weeding combining with dicot-weeds



... looking behind the data by treatment :

# Effect of mechanical weeding combining with dicot-weeds



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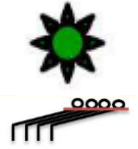
- Except for HR, the sole use of mechanical weeding (without dicot-herbicide) tend to have a positive impact in comparison to control plot (➔)
- Intense mechanical weedings combined to dicot-herbicide have a detrimental impact on yield compared with the sole chemical reference (➔)

**/!\ Selectivity of mechanical weeding**  
as discussed by Rasmussen et al. , 2008

# Conclusion

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## Mechanical weeding impact on weed population

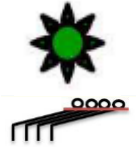


→ Weed reduction ~40% with the most intensive mechanical weed treatment (rotary hoe/harrow + harrow)

# Conclusion

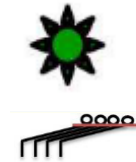
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## Mechanical weeding impact on weed population



→ Weed reduction ~40% with the most intensive mechanical weed treatment (rotary hoe/harrow + harrow)

## Effect of mechanical weeding combined with dicot-weeds on weed population



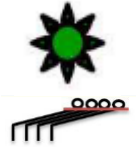
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→ No ranking of mechanical control when chemical are applied

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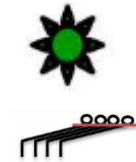
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## Mechanical weeding impact on weed population



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## Effect of mechanical weeding combined with dicot-weeds on weed population



→ Good response to chemical weeding application starting at ½ dose (confirm by year 1 and 2)

→ No ranking of mechanical control when chemical are applied

## Global impacts on yield



→ Dicot-herbicide exhibited the highest performances in terms of yield

/!\ depends on year and/or initial weeds pressure

→ Mechanical weeding without dicot-herbicide have a good impact on yield compared to control

/!\ depends on year:

→ year 1: no effect

→ year 2: highest yield with 1 harrow

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# Initial heterogeneity

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
600	68	56	28	36	64	64	44	20	36	48	76	60	48	36	32	20	52	32	28	24
	44	108	84	56	88	36	40	16	48	32	144	60	64	72	52	52	44	68	28	36
500	64	60	64	48	56	76	72	40	60	40	76	68	104	56	68	48	68	88	96	48
	88	36	24	76	52	44	64	32	68	92	36	60	100	96	76	84	120	84	76	52
400	104	92	56	52	60	92	72	36	108	100	116	68	100	136	128	100	120	76	128	88
	108	180	80	108	112	124	140	64	160	208	128	128	132	124	120	148	152	160	72	72
300	204	128	140	176	164	120	204	160	136	216	180	104	192	200	236	148	220	156	144	116
	144	172	148	136	134	192	248	176	232	184	144	148	140	168	168	192	192	212	128	96
200	244	320	220	240	52	188	236	220	300	184	156	156	116	216	188	224	264	172	120	112
	292	488	296	260	140	240	244	316	336	276	256	108	188	260	264	324	444	136	132	108
100	324	388	440	268	200	260	284	464	468	516	264	108	156	352	468	552	404	176	136	108
	288	276	292	252	252	324	212	404	612	356	224	168	184	256	620	456	348	208	88	156