Universitat de Lleida

INTEGRATED MANAGEMENT OF MULTIPLE RESISTANT *AMARANTHUS PALMERI*

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Scenario in Spain

Resistance to ALS (group 2 / A)

❖ Resistencia to SUs in populations from North-Eastern Spain (Torra et al. 2020)

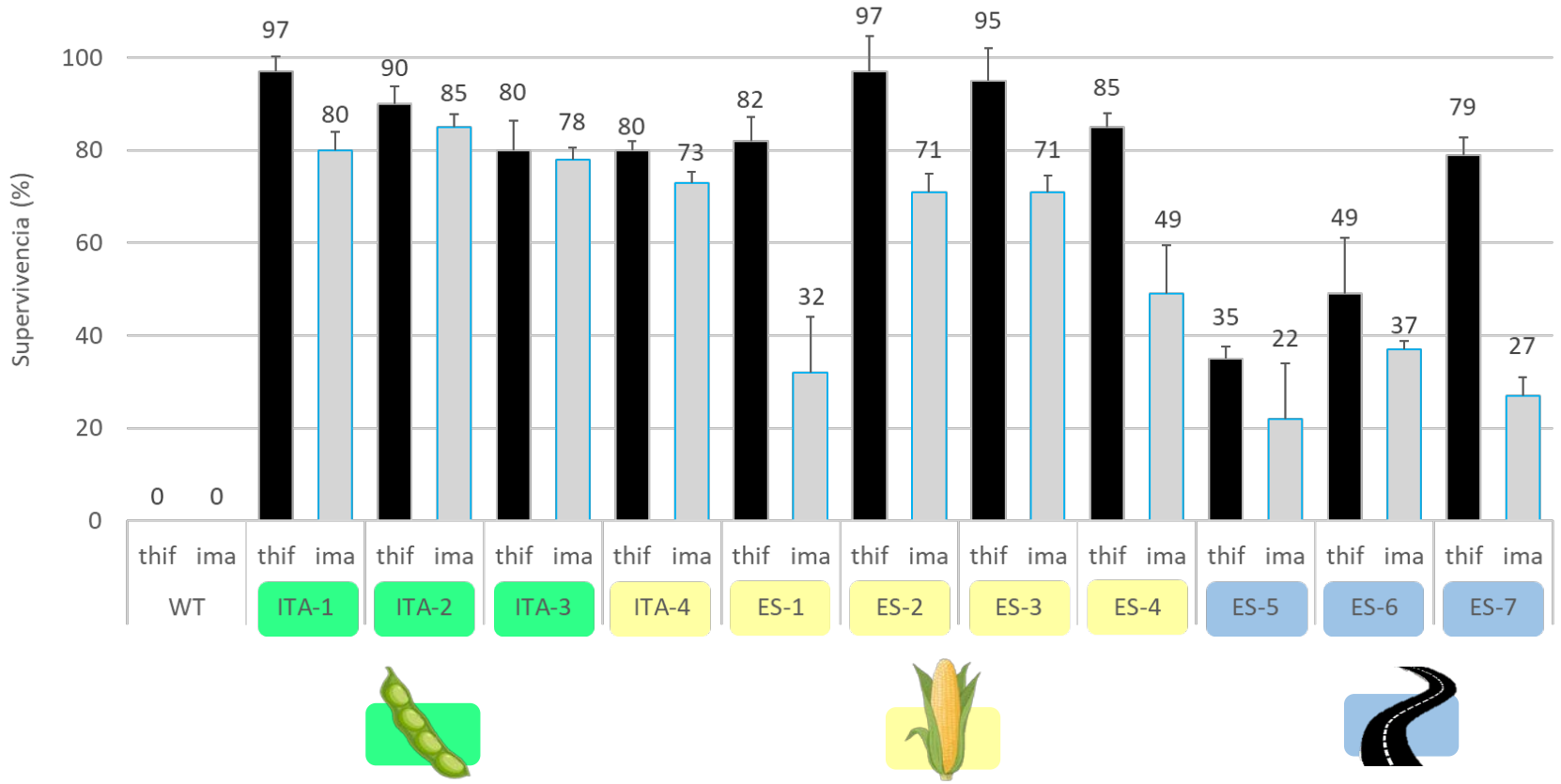
- ➢ Since then, almost all populations are resistance to group 2 (North-Eastern Spain and South-western, Cataluña, Aragón y Extremadura)
- ➢ Resistance levels and cross-resistance patterns very variable (Pro197, Asp376, Trp574, Ser563)

C- THIF IMA

W T

C- THIF IMA

R



Manicardi et al. (2025) Pest Manag Sci

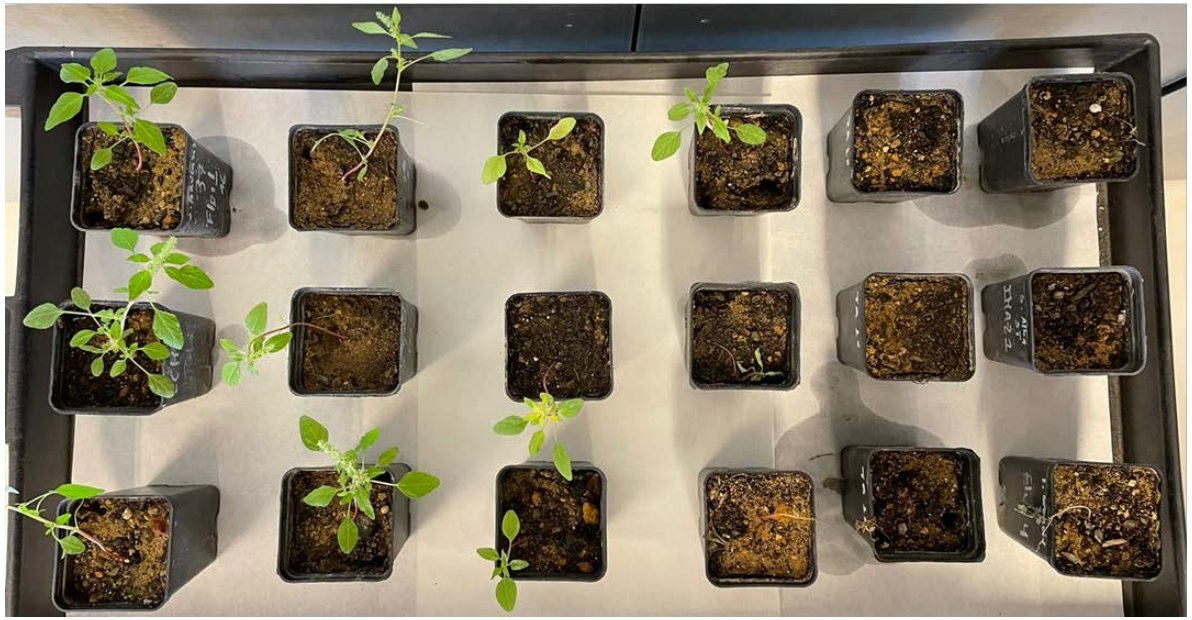
Scenario in Spain

Glyphosate (group 9 / G)

- **First two resistant populations from road margins in Catalonia collected in 2022 (Manicardi et al. 2025)**
  - Low resistance levels (even with high CNV), and low frequency of R plants
  - Recently, confirmed another population in Aragón (Trébol-Aizpurua et al., 2025) Agronomy

g i.a. ha -1

135	270	540	1080	2160	4320



Manicardi et al. (2025) Weed Res

Scenario in Spain

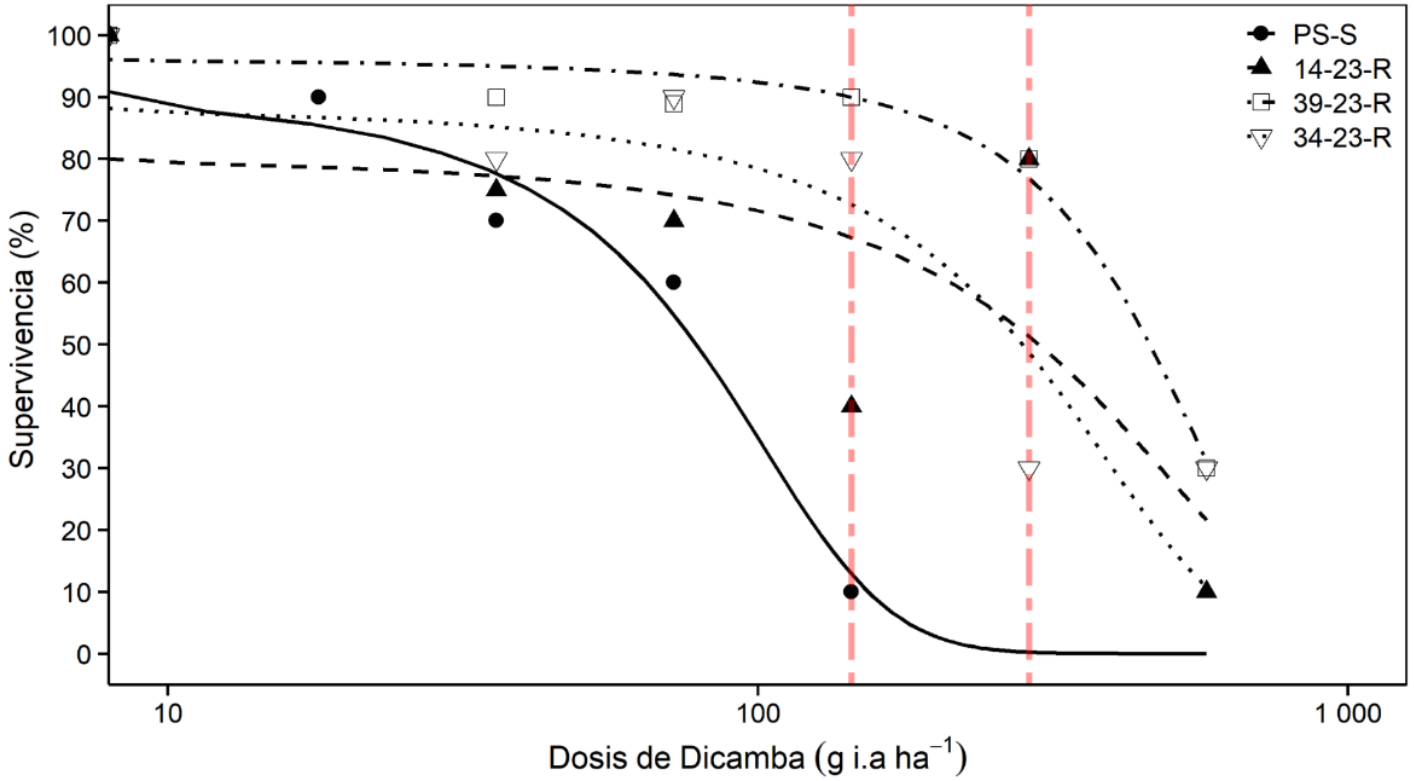
Multiple R to Glyphosate and ALS

- **Confirmed at plant/population level in roadsides**
  - ALS mutation and EPSPS CNV at plant level

Fuente: Manicardi et al. (2025)

Resistance to Dicamba (group 4/O)

- **Confirmed in some populations from North-Eastern Spain**



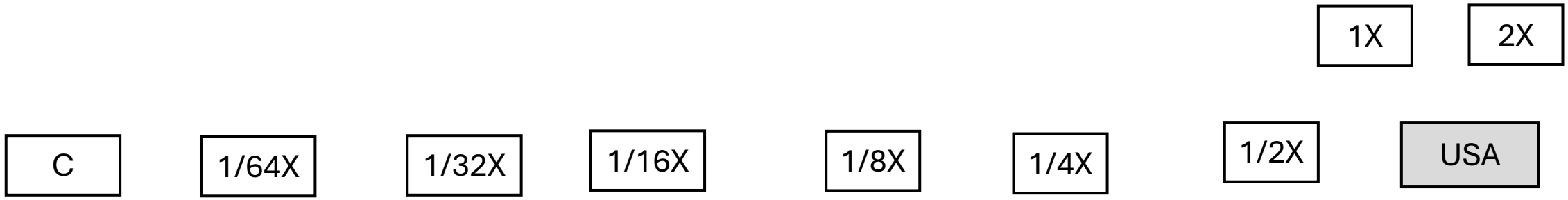
Scenario in Spain

Resistance to Mesotrione (HPPD, group 27/F2)

- **Confirmed in one population from North-Eastern Spain**

t=21 días

AUGUST-2025



Scenario in Spain

Multiple R to Glyphosate and ALS inhibitors

¿Multiple R to HPPD amd ALS inhibitors?

¿Multiple R to dicamba and ALS inhibitors?

¿Multiple R to HPPD and ALS inhibitors, plus dicamba?

POST-EMERGENCE IS NOT AN OPTION (only after PRE)

Scenario in Spain

Management undertaken

- **PREVENTION**

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ORDEN A. PALMERI

ORDEN ARP/172/2019, de 10 de septiembre, por la cual se declara la existencia de la mala hierba *Amaranthus palmeri* y es califica de utilidad pública la lucha contra ella.

Management undertaken

❖ **PREVENTION**

- Harvest from clean fields to infested fields
- In a dirty field, harvest from the dirty area to the clean area

Management undertaken

- **PREVENTION**
  - Cleaning of the machinery

Management undertaken

- **HERBICIDES**

Management undertaken

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Departament d'Agricultura, Ramaderia, Pesca i Alimentació

❖ HERBICIDES

Nº de tractament	Producte	Composició	Dosi 1 l/ha	Dosi 2 l/ha	Dosi 3 l/ha	Moment 1	Moment 2
1	Primextra+Adengo	S-METOLACLORO 31,25% + TERBUTILAZINA 18,75% + ISOXAFLUTOL 22,5% + TIENCARBAZONA-METIL 9%	3,5	0,4		PRE (00-09)	
2	Spectrum	DIMETENAMIDA-P 72%	1,4			PRE (00-09)	
3	Wing P	DIMETENAMIDA-P 21,25% + PENDIMETALINA 25%	4			PRE (00-09)	
4	Terdim	DIMETENAMIDA -P 26,5%+TERBUTILAZINA 30%	2,8			PRE (00-09)	
5	Adengo	ISOXAFLUTOL 22,5% + TIENCARBAZONA-METIL 9%	0,44			PRE (00-09)	
6	Successor T	PETOXAMIDA 30% + TERBUTILAZINA 18,75%	4			PRE (00-09)	
7	Spectrum +Iseran	DIMETENAMIDA-P 72% + CLOMAZONA 8% + MESOTRIONA 15%	1,4	1		PRE (00-09)	
8	Spectrum+Evolya	DIMETENAMIDA-P 72% + MESOTRIONA 50%	1,4	0,3		PRE (00-09)	
9	Spectrum +Adengo	DIMETENAMIDA-P 72% + ISOXAFLUTOL 22,5% + TIENCARBAZONA-METIL 9%	1,4	0,44		PRE (00-09)	
10	Wing P+Iseran	DIMETENAMIDA-P 21,25% + PENDIMETALINA 25% + CLOMAZONA 8% + MESOTRIONA 15%	4	1		PRE (00-09)	
11	Successor + Iseran	PETOXAMIDA 60%+ CLOMAZONA 8% + MESOTRIONA 15%	2	1		PRE (00-09)	
12	Iseran	CLOMAZONA 8% + MESOTRIONA 15%	1			PRE (00-09)	
13	Experimental 25		1,75			PRE (00-09)	
14	Evolya	MESOTRIONA 50%	0,3			PRE (00-09)	
15	Experimental 10	DFF 50% SC	0,2			PRE (00-09)	
16	Onyx+Wing P	PIRIDATO 60%+DIMETENAMIDA-P 21,25% + PENDIMETALINA 25%	1,5	4		POST (11)	
17	Banvel	DICAMBA 48%	0,6			POST (12-13)	
18	Capreno+Mero	TEMBOTRIONA 34,5% + TIENCARBAZONA-METIL 6,8%	0,29	2		POST (12-13)	
19	Banvel+Capreno+Mero	DICAMBA 48%+ TEMBOTRIONA 34,5% + TIENCARBAZONA-METIL 6,8%	0,6	0,29	2	POST (12-13)	
20	Onyx+Casper+Agral	PIRIDATO 60% + DICAMBA 50% (SAL SÓDICA) + PROSULFURON 5%	1,5	0,4	0%	POST (12-13)	
21	Experimental 5		1			POST (11)	POST (13)
22	Onyx	PIRIDATO 60%	1,5			POST (11)	POST (13)
23	Experimental 4 + Banvel-D	Experimental+ Dicamba	1,5	0,6		POST (12-13)	
24	Spectrum+Iseran+Capreno+Mero	DIMETENAMIDA-P 72% + CLOMAZONA 8% + MESOTRIONA 15% +TEMBOTRIONA 34,5% + TIENCARBAZONA-METIL 6,8%	1,4	1		PRE (00-09)	POST (14)
25	Testimoni						

Management undertaken

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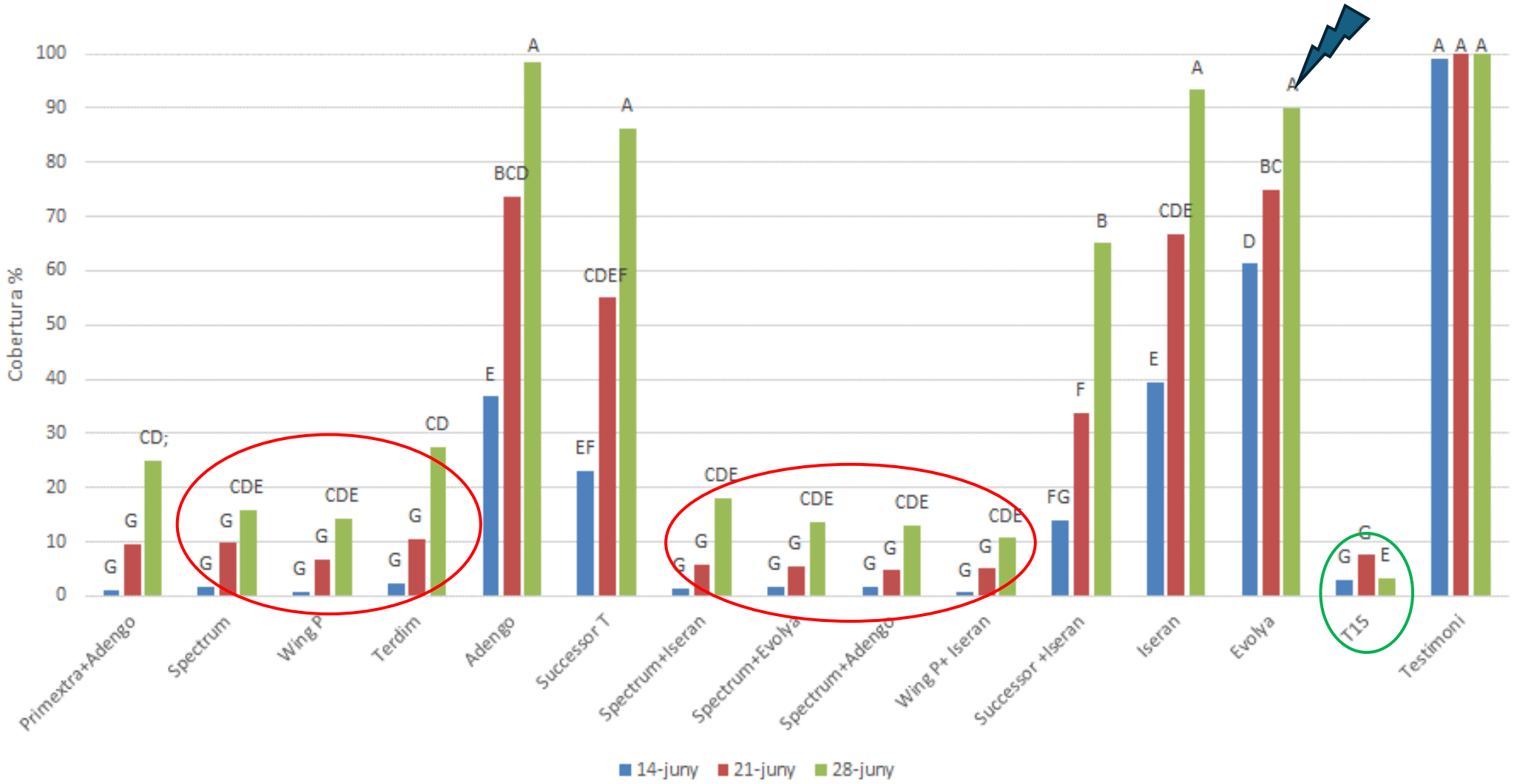
❖ **HERBICIDES** **PRE**



Management undertaken

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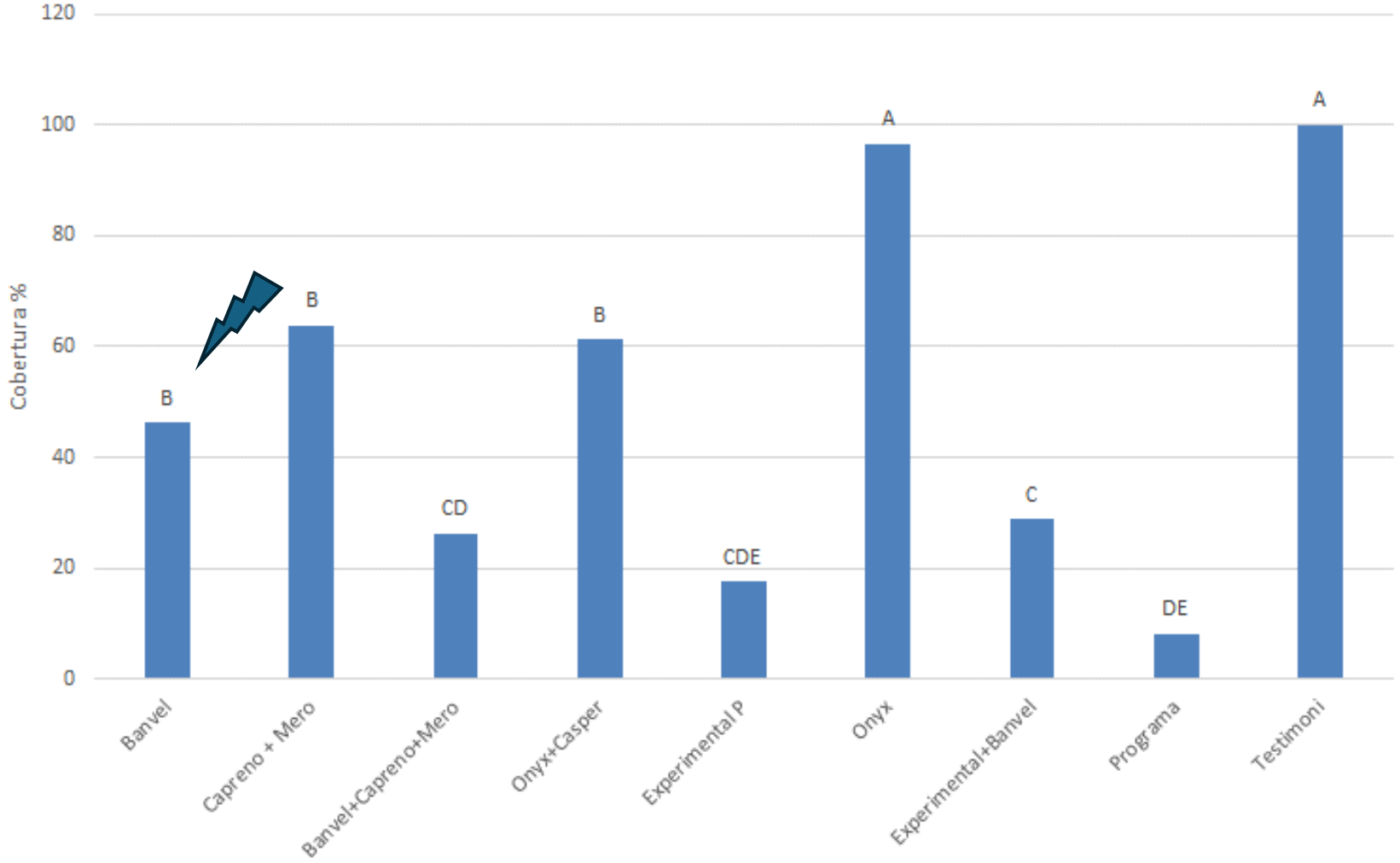
❖ **HERBICIDES** **POST**



Management undertaken

- **HERBICIDES**

Management undertaken

❖ HERBICIDES

- Dimethenamid, particularly **DFF**, in mixture, and sometimes with a third MoA: is the standard treatment in infested fields
- Farmers are applying a lot DFF (90% fields)
- If water and aquifers get contaminated (as for S-MOC here, few years ago, one of the drivers of its banning)……
- We can loose the only viable chemical options right now

Management undertaken

❖ NON-CHEMICAL STRATEGIES

- Inter-row mechanical control (w in row PRE)

- The objective is reducing selection pressure with a single MoA, and overall herbicide selection pressure

Management undertaken

❖ NON-CHEMICAL STRATEGIES

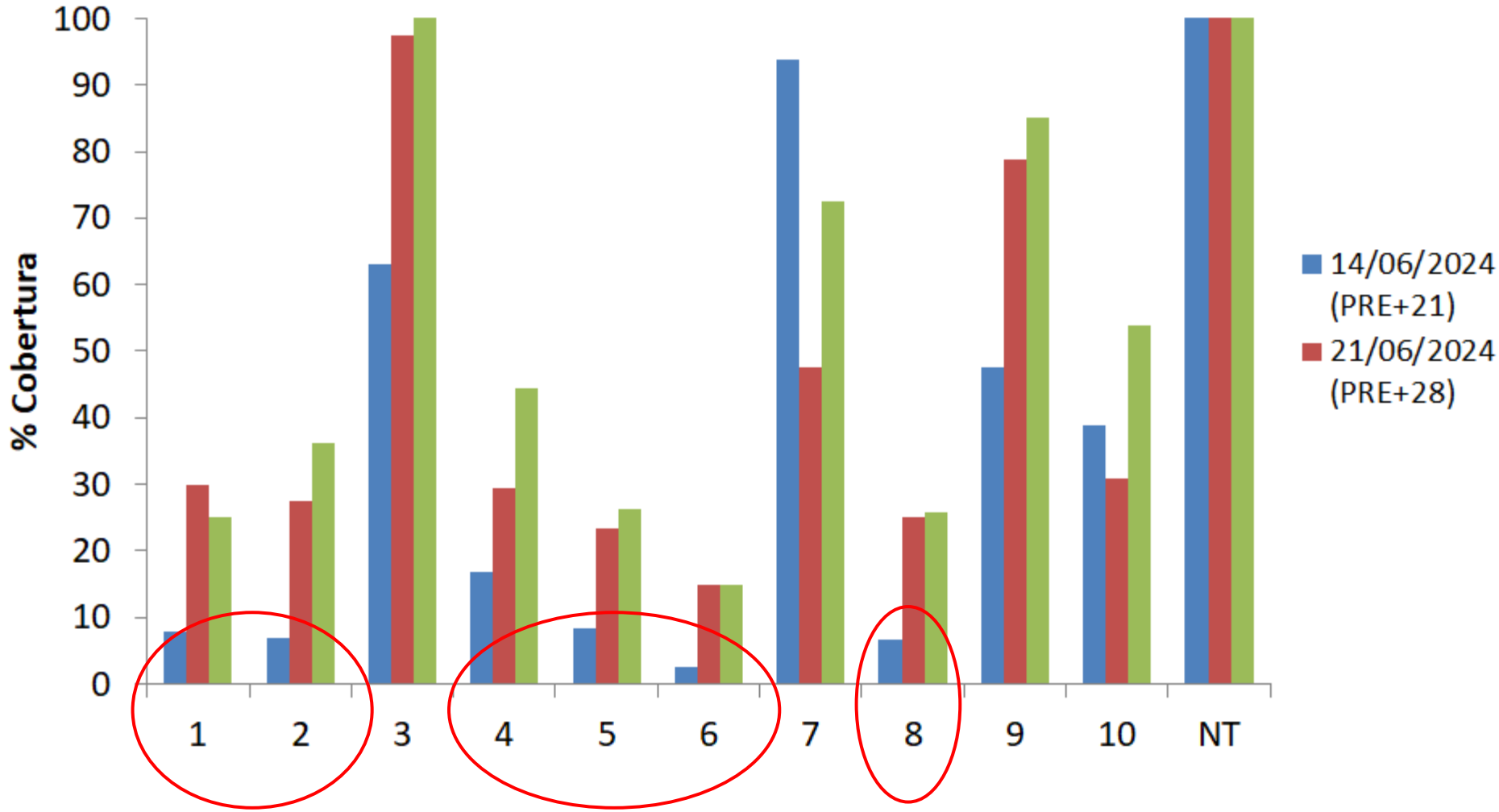
➢ Crop rotation: sunflower

Nº	Producte	Composició	Dosi 1 l/ha	Dosi 2 l/ha	Dosi 3 l/ha	Moment 1 (24-maig)	Moment 2 (10-juny)	Moment 3 (25-juny)
1	Challenge	Aclonifen 60%	4			PRE (00-09)		
2	Challenge+Stomp Aqua	Aclonifen 60%+Pendimetalina 45,5%	3	2		PRE (00-09)		
3	Primextra	S-Metolacloro 31,25% + terbutilazina 18,75%	3			PRE (00-09)		
4	Stomp Aqua+Soleto	Pendimetalina 45,5% + Metobromuron 50%	2,6	2		PRE (00-09)		
5	EXP1	EXP1	3,2			PRE (00-09)		
6	EXP1+Challenge	EXP1 +Aclonifen 60%	2	2		PRE (00-09)		
7	Sunbright + Dash	Aclonifen 30% + Imazamox 2%	1,35				POST (12-13)	
8	(Challenge+Stomp Aqua)+(PULSAR 40)	Aclonifen 60% + Pendimetalina 45,5% + (Imazamox 4%+Dash)	3	2	1,25	PRE (00-09)		POST (14-15)
9	Stomp Aqua	Pendimetalina 45,5%	2,6			PRE (00-09)		
10	Stomp Aqua+(Pulsar 40+Dash)	Pendimetalina 45,5%+ Imazamox 4%	2,6	1,25		PRE (00-09)	POST (12-13)	
NT	Testimoni							

Management undertaken

❖ NON-CHEMICAL STRATEGIES

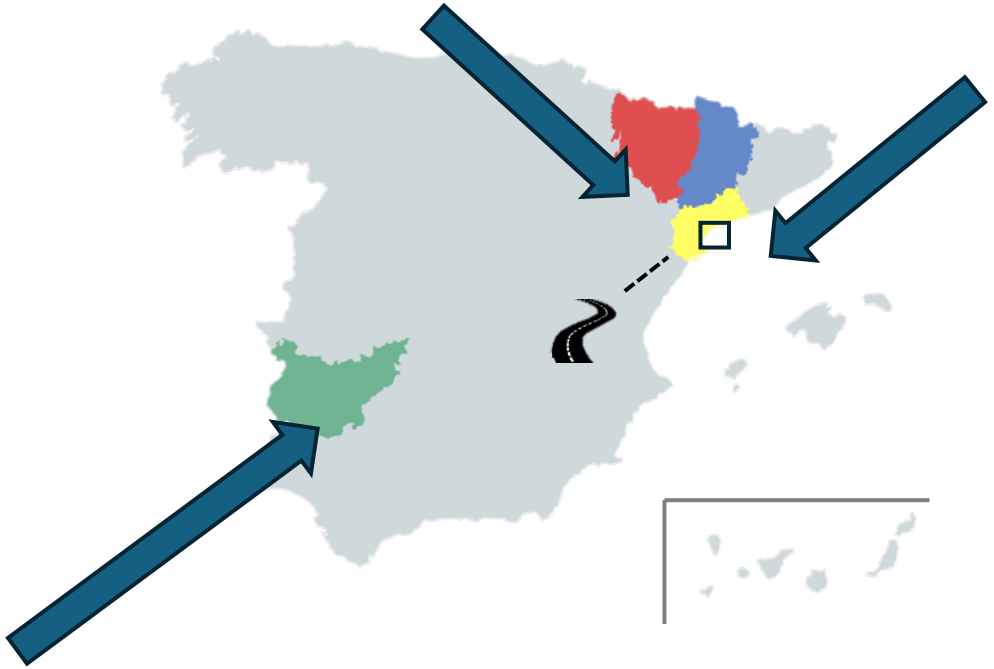
➢ Crop rotation:
sunflower



Management undertaken

❖ **COMMUNICATION**

➢ Plant Protection Services from each affected region



cita
CENTRO DE INVESTIGACIÓN Y TECNOLOGÍA AGROALIMENTARIA DE ARAGÓN

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CICYTEX
CENTRO DE **INVESTIGACIONES CIENTÍFICAS Y TECNOLÓGICAS** DE EXTREMADURA

Management undertaken

❖ **COMMUNICATION**

https://redpalmer.net/

Management undertaken

❖ **COMMUNICATION**

https://redpalmer.net/

Management undertaken

❖ **FUTURE**

- Follow-up Hybrid strategies
- AGAIN: The objective is reducing selection pressure with a single MoA, and overall herbicide selection pressure
  - In-row PRE herbicides + interrow mechanical control
  - In-row PRE herbicides + interrow cover crops
  - Crop rotation strategies

Management undertaken

- **And worsening**

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THANKS FOR YOUR ATTENTION

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