

Papaver rhoeas plants with multiple resistance to synthetic auxins and ALS inhibitors

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Purpose

Investigate possible multiple resistance in a *P. rhoeas* population collected from a cereal field where 2,4-D application resulted in poor control, in an area with reported resistance to ALS inhibitors.

Methodology

Plant material: 10 individual plants that survived 2,4-D field application (pop. F3B) and reference sensitive population (REF). Material collected in June 2013.



Leaves

DNA extraction

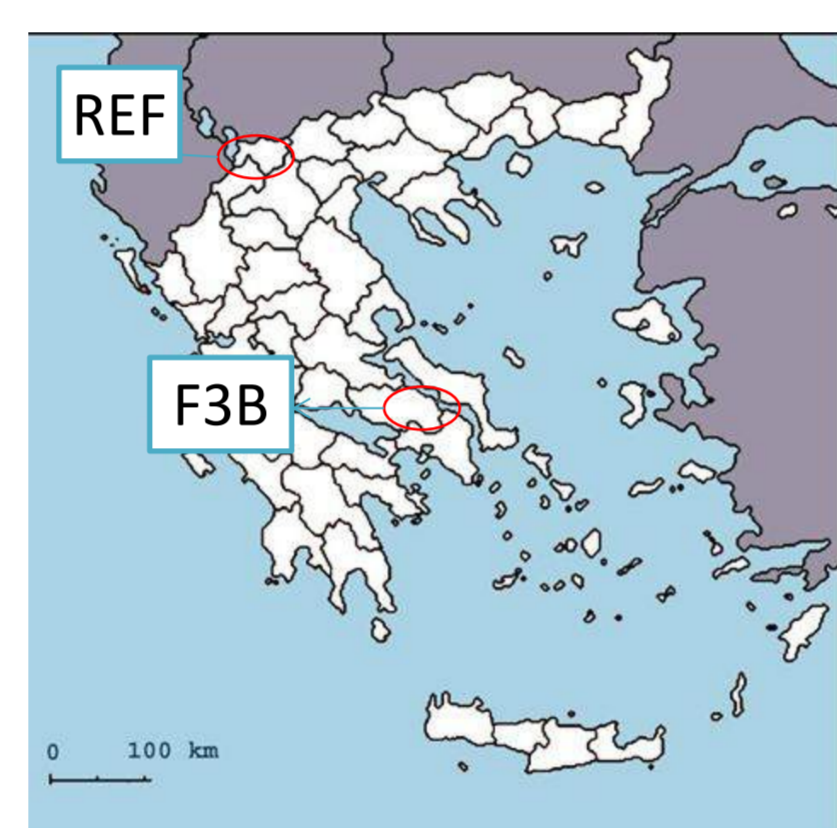
genotyping

at ALS codons:

Pro197 and Trp574

with dCAPS

(Délye C et al. 2011. *Plant Science*,180: 333–42)



Populations location

Seeds

Germination

508 progeny F3B
41 REF plants

Dose response experiment

Herbicide: 2,4-D (ester form)

Recommended field rate: 600 g a.e./ha

F3B: 0, 150, 300, 600, 1200, 2400, 4800 g a.e./ha

REF: 0, 37.5, 75, 150, 300, 600, 1200 g a.e./ha

12 weeks after herbicide application:

- Visual assessment of herbicide efficacy

R: resistant plants, no visible symptoms

r: plants with visible symptoms

S: dead plants

- Dry weights analysed with R software, drc package (log-logistic four parameter model)

$$f(x, (b, c, d, e)) = c + \frac{d - c}{1 + \exp \{b(\log(x) - \log(e))\}}$$

d: upper limit, c: lower limit, e: ED50, b: relative slope around e
(Ritz C, Streibig JC (2005) *Bioassay Analysis using R. J Stat Softw.* 12: 1–22)

Results

Parental plant	ALS genotype ^a		Progeny - Visual assessment (%)								
			600 g ae/ha (field rate)			2400 g ae/ha			4800 g ae/ha		
	Pro197	Trp574	R	r	S	R	r	S	R	r	S
F3B-01	RR	SS	83	17	0	33	17	50	0	0	100
F3B-05	RR	SS	100	0	0	17	17	67	17	0	83
F3B-06	RS	SS	67	0	33	0	0	100	17	0	83
F3B-07	RS	SS	90	10	0	0	30	70	10	0	90
F3B-08	SS	SS	83	0	17	0	17	83	0	0	100
F3B-09	RS	SS	50	0	50	8	0	92	0	0	100
F3B-10	RS	SS	60	40	0	20	20	60	0	20	80
F3B-11	RR	SS	40	40	20	0	20	80	0	0	100
F3B-12	RS	SS	100	0	0	67	0	33	0	0	100
F3B-13	RS	SS	64	9	27	18	9	73	0	0	100
REF	SS	SS	0	0	100	0	0	100	0	0	100

^a RR: homozygous mutant, RS: heterozygous mutant, SS: wild type

- A total of 9 parental plants contained at least one mutant allele at Pro197, of which 3 were homozygous mutants
- No mutation was found at Trp574
- Herbicide rates ≥ 150 g a.e./ha gave 100% REF control
- In all progenies, several plants survived at rates > field rate

Dose response analysis of dry weights

Progeny	ED50	CI (95%)	R/S
REF	37	17; 57	
F3B-08	1373	598; 2147	37
F3B-12	1127	288; 1968	30



600 (field rate) 1200 2400 4800 (g a.e./ha)

Efficacy of various 2,4-D rates on F3B progeny

Conclusions

- First evidence of a *P. rhoeas* population with multiple resistance to ALS inhibitors and synthetic auxins
- Variation in the response to herbicide treatments among and within progenies suggests resistance to synthetic auxins is polygenic
- Confirmation that ALS Pro197 mutation in *P. rhoeas* is established in the area