

# Environmental friendly management of *Ecballium elaterium* in almond orchards based on understanding the relationship between spatial distribution, weed biology and chemical control

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## Introduction

- Squirting cucumber (*Ecballium elaterium*) is a native weed to the Mediterranean region. It has unique seed dispersal mechanism which is based on ejection of the seeds from the fruit when it ripens.
- The annual cost for weed management of almond orchards in Israel is 250\$ ha<sup>-1</sup> per year.
- The distribution of squirting cucumber in Israel increased in the past years as a result of banning the use of key herbicides i.e. simazine and trifluraline.
- Distribution of weeds in field crop, vegetables and orchards is often patchy, meaning that some regions in the fields infested with high density of weeds next to areas infested with low weeds density.
- Understanding the spatiotemporal dynamic of weed patches can help to develop weeds map to be used in site-specific weed management aiming precise herbicides application.

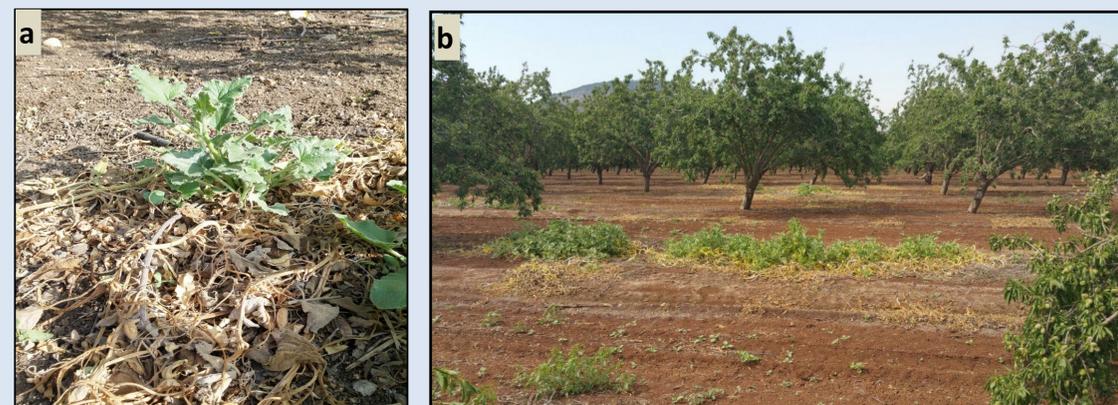


Fig 1: Squirting cucumber plant after luroxyppy application in almond orchards (a). Patch of Squirting cucumber in Ein Dor almond orchard (b).

## Materials and methods

- We mapped the location of all squirting cucumber plants in seven different orchards in north of Israel, using GPS (ArcPad, ESRI) and GIS (ArcMap, ESRI).

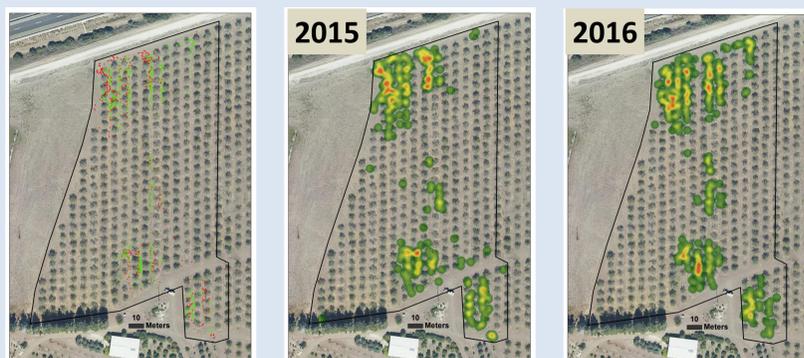


Fig 2: Location of squirting cucumber plants (left); Heatmap analysis of Neve Ya'ar almond orchard in 2015 (center) and in 2016 (right)

- The plants were grown in a greenhouse under temperature controlled conditions (25°C / 15°C, D/N). Herbicides were applied in two phenological stages: 2-3 leave stage and flowering stage. We used six commercial herbicide formulations, in two doses, using a sprayer delivering 200 L ha<sup>-1</sup>. Visual evaluation of the plants was recorded 21 days after the treatment.

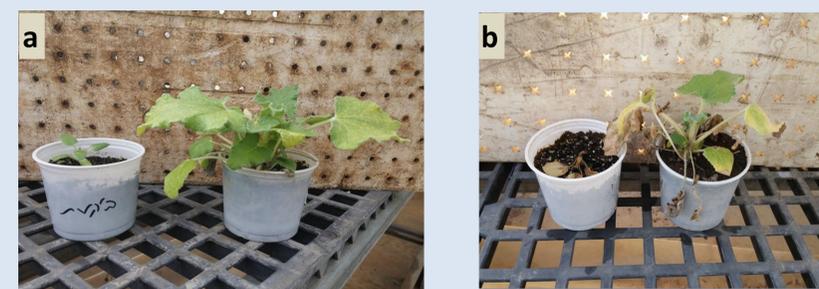


Fig 3: Squirting cucumber plants (a) control, (b) trifloxysulfuron (0.075 kg/ha) treatment

## Results

- Flowering stage:** Treatment with 2,4D, glufosinate ammonium, fluroxyppy absolutely controlled the Squirting cucumber. Glyphosate controlled only 50% (out of non-treated control); trifloxysulfuron 54%-6%; and pyriithiobac sodium reduced control efficacy to only 5%-8%.
- 2-3leave stage:** 2,4D, glufosinate ammonium, fluroxyppy, absolutely controlled the Squirting cucumber plants. Glyphosate controlled only 54% in two doses, pyriithiobac sodium 19%-2% and trifloxysulfuron 10%-8%.

Table 1: Control of squirting cucumber in 2 phenological stages under treatment of 6 herbicides in 2 doses.

Flowering			2-3 leave		
Herbicide (A.I)	(kg/ha)	control (%)	Herbicide (A.I)	(kg/ha)	control (%)
Glufosinate Ammonium	0.8	100	2,4D	1.34	100
Glufosinate Ammonium	0.6	100	2,4D	1	98
2,4D	1.34	97	Fluroxyppy	0.3	92
2,4D	1	98	Fluroxyppy	0.16	89
Fluroxyppy	0.2	94	Glufosinate Ammonium	0.8	88
Fluroxyppy	0.16	89	Glufosinate Ammonium	0.6	95
Glyphosate	2.4	54	Glyphosate	2.4	46
Glyphosate	1.92	54	Glyphosate	1.92	34
Trifloxysulfuron	0.075	54	Pyriithiobac Sodium	0.051	19
Trifloxysulfuron	0.0112	6	Pyriithiobac Sodium	0.068	2
Pyriithiobac Sodium	0.051	8	Trifloxysulfuron	0.075	10
Pyriithiobac Sodium	0.068	5	Trifloxysulfuron	0.0112	8

- Spatial pattern was analyzed using an Average Nearest Neighbor analysis. Results revealed that in all seven fields squirting cucumber displayed spatial clustering pattern. However, the patch size and density varied between plots.

Table 2: Number of plants and the average distance between plants per plot.

Plot name	2015		2016	
	Number of plants	Average distance between plants (meters)	Number of plants	Average distance between plants (meters)
Ein dor 1	297	2.89	505	1.09
Ein dor 2	239	1.55	147	1.34
Ein dor 3	155	2.42	294	1.36
Neve Ya'ar north	443	1.47	768	0.72
Neve Ya'ar south	280	1.62	515	0.87
Yizrael	287	1.8		
Mavo Hama	1061	1.1		

## Conclusions

Site specific weed management is a proven environmental friendly approach for control and reducing herbicide use. In this study we have showed that squirting cucumber tend to aggregate in patches that retain their locations in a consecutive year. This is the first step in quantifying the spatio-temporal dynamic of the patches. We intend to further analyze the data to answer the following questions: do the patches confounded to the same locations? are there changes in the locations between years? what characterize the locations of these patches? These are fundamental questions in ecology and will aid in formulating spatial strategies for weeds management and will lead to reducing the use of herbicides.

## References

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