



Developing soil Fumigation alternatives to reduce agricultural pesticide exposure

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Biosolarization is...

...an alternative to conventional soil fumigation for pest control.

...a technology to reduce the inherent health risks associated with agricultural use of toxic pesticides.



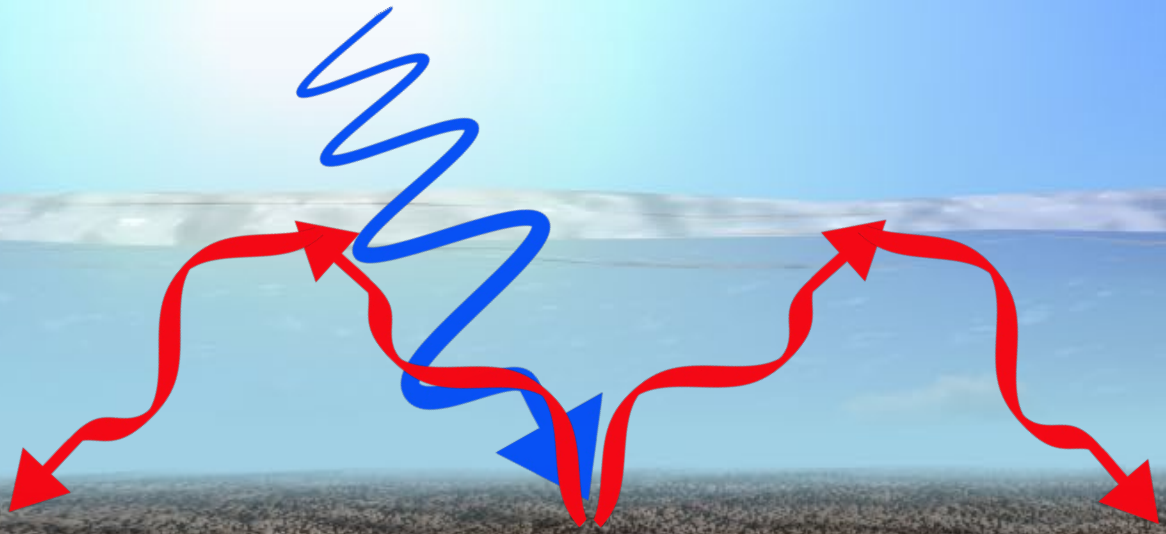
An aerial photograph showing a series of parallel furrows in a field. Each furrow is filled with a clear plastic mulch film. The furrows are separated by raised mounds of brown soil. The overall scene depicts a prepared agricultural field ready for planting and irrigation.

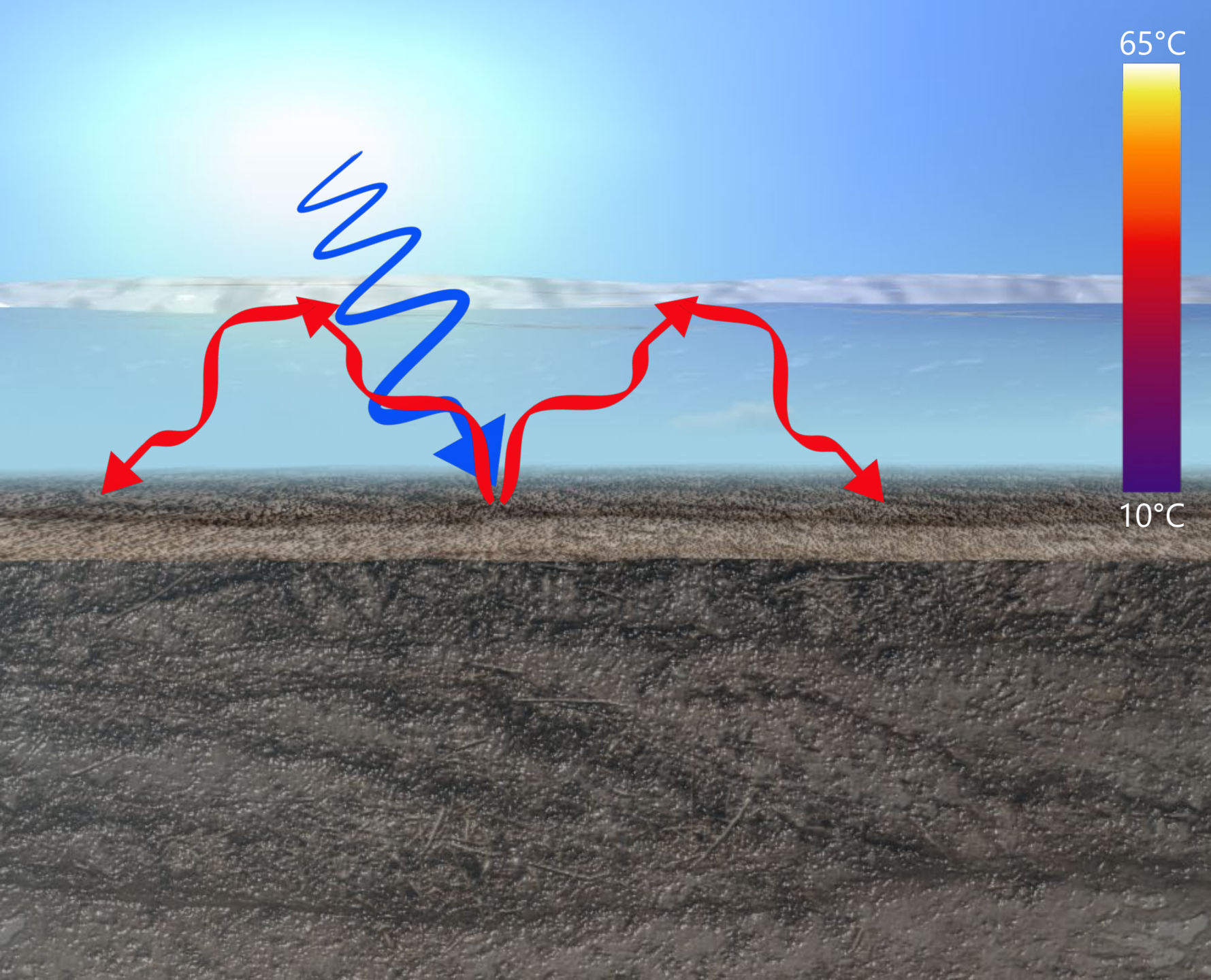
**APPLY CLEAR FILM AND
IRRIGATE TO FIELD CAPACITY**

Atmosphere

Tarp

Soil

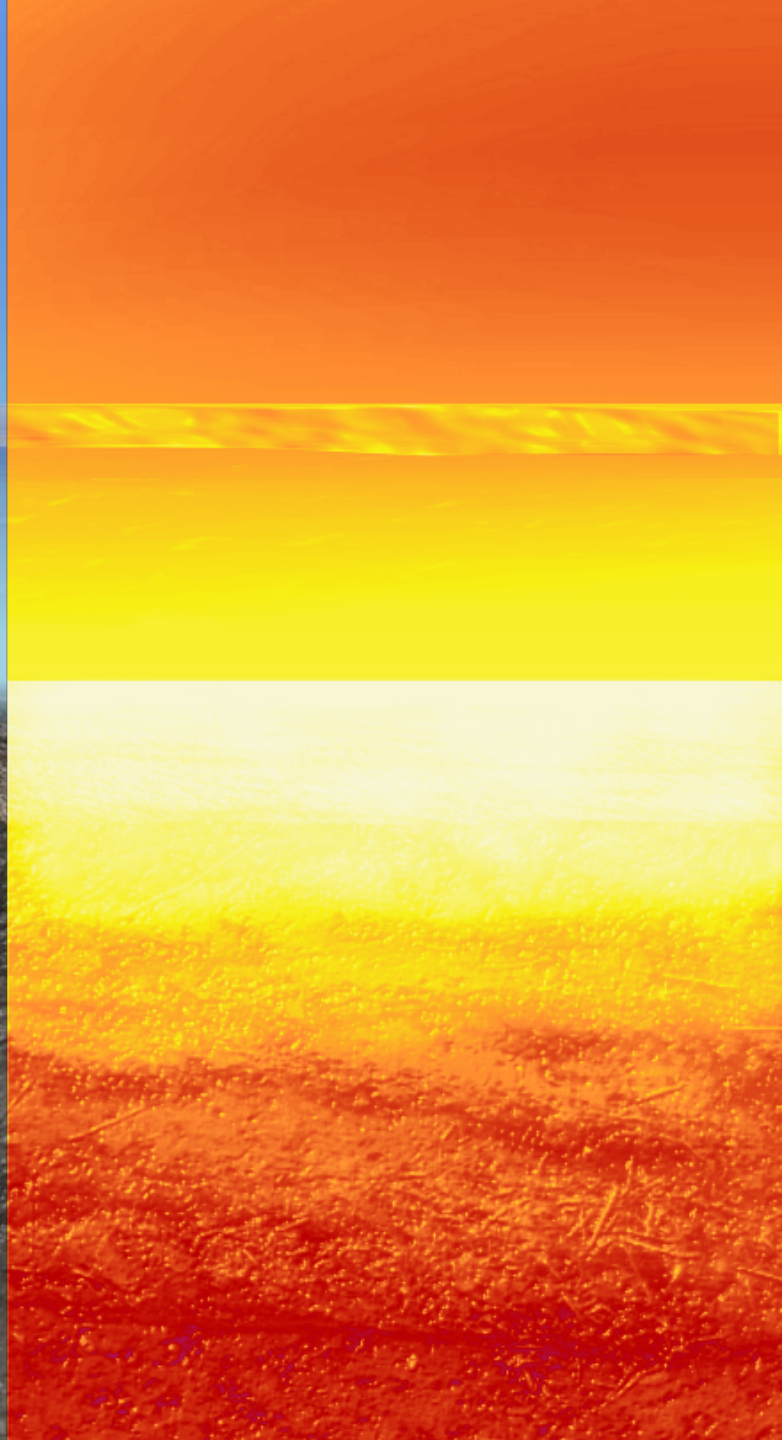


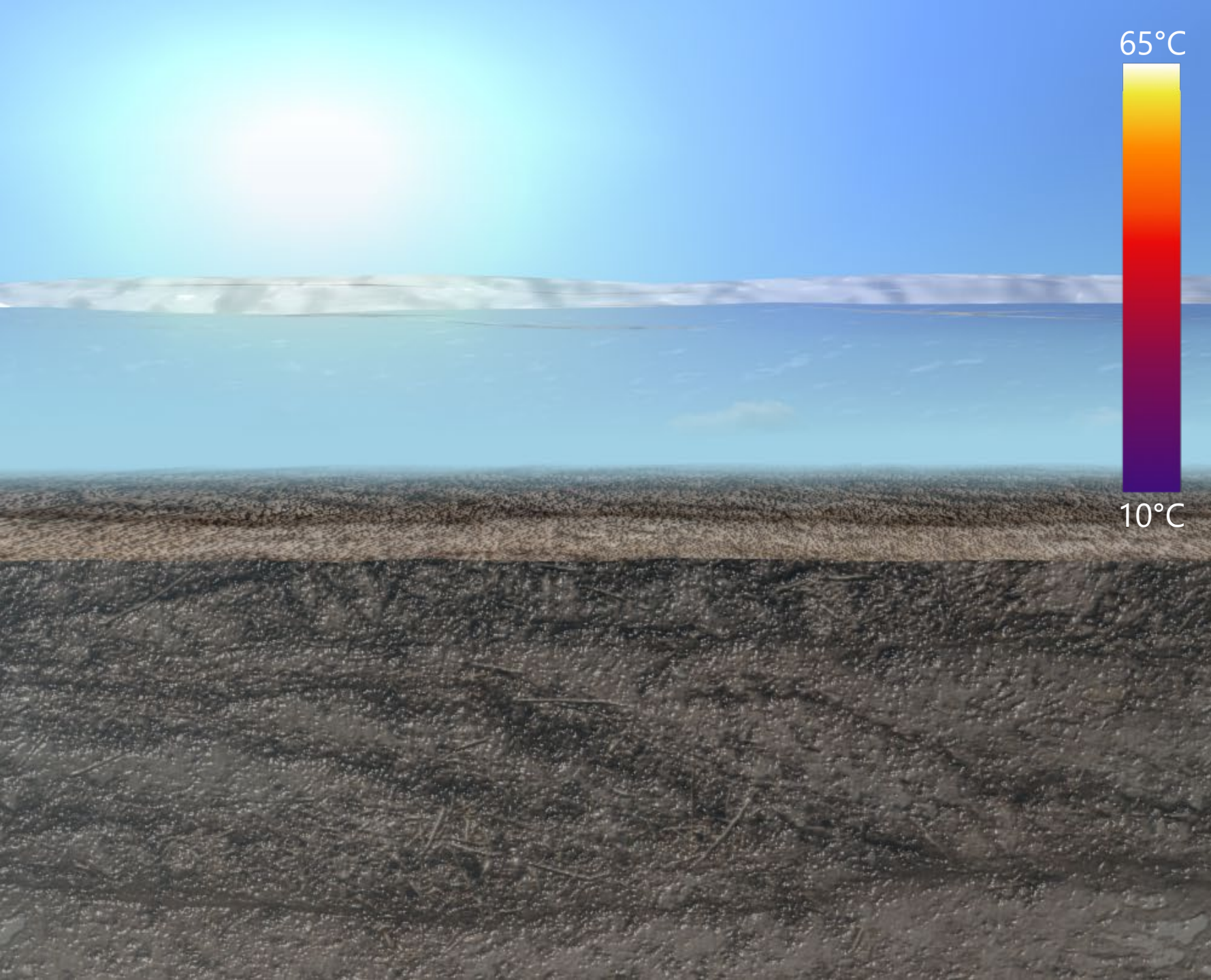


65°C



10°C

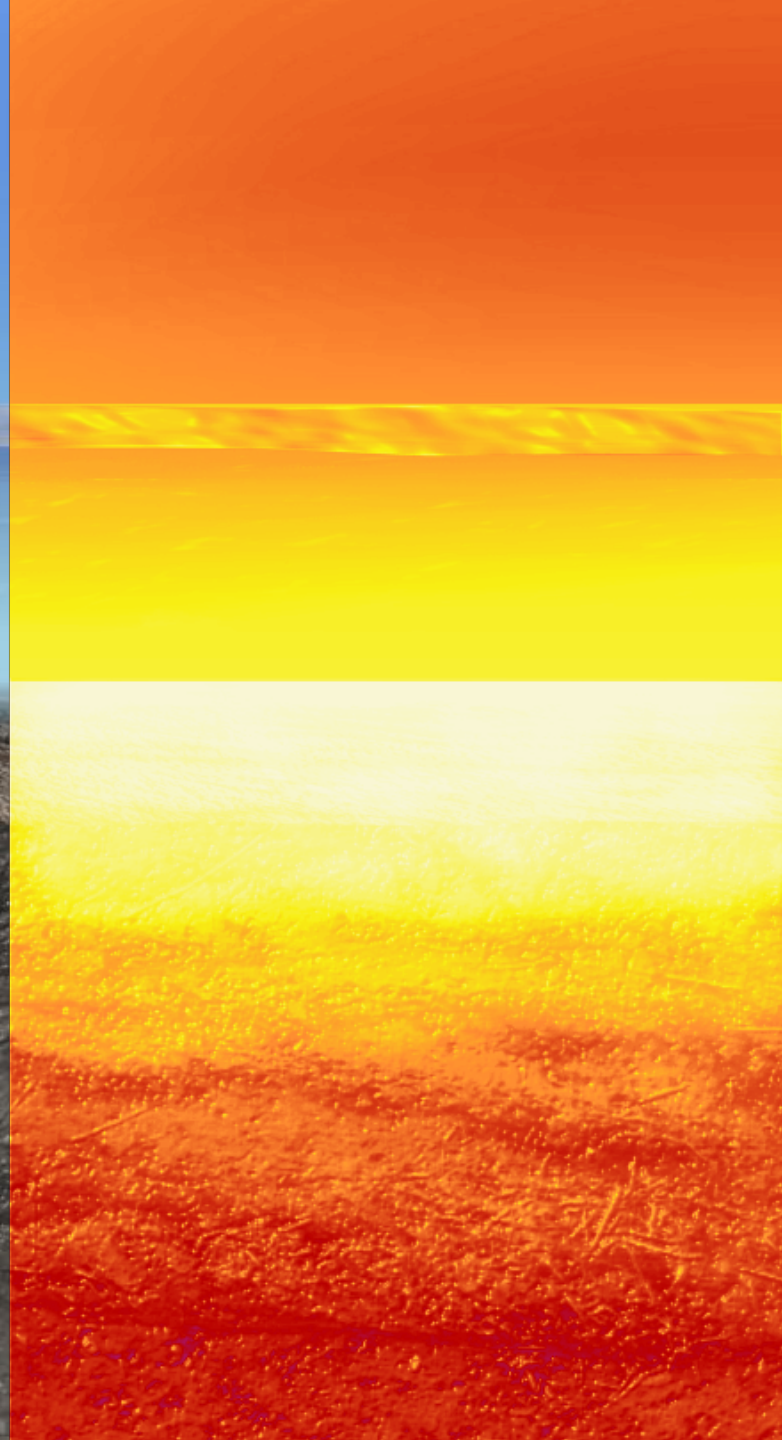




65°C



10°C



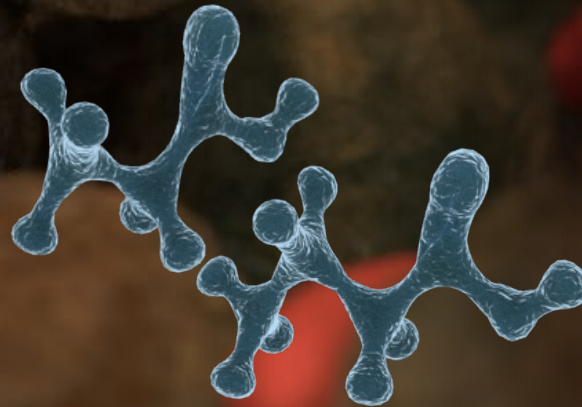
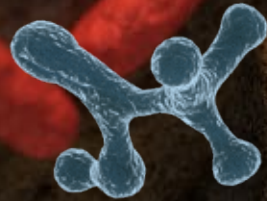
BACTERIA PRODUCE BIOPESTICIDES VIA ANAEROBIC FERMENTATION

FOR EXAMPLE, ORGANIC ACIDS:

ACETIC ACID

PROPIONIC ACID

BUTYRIC ACID



Project goals

An aerial photograph of a large agricultural field. The field is divided into several sections. The central section is covered with a grid of white plastic mulch, used for biosolarization. To the left and right of this central section are rows of green crops, likely alfalfa. In the background, there is a line of trees and some buildings, suggesting a rural or semi-rural setting. The sky is clear and blue.

Maximize biosolarization efficacy in California agriculture

Measure soil emissions during biosolarization

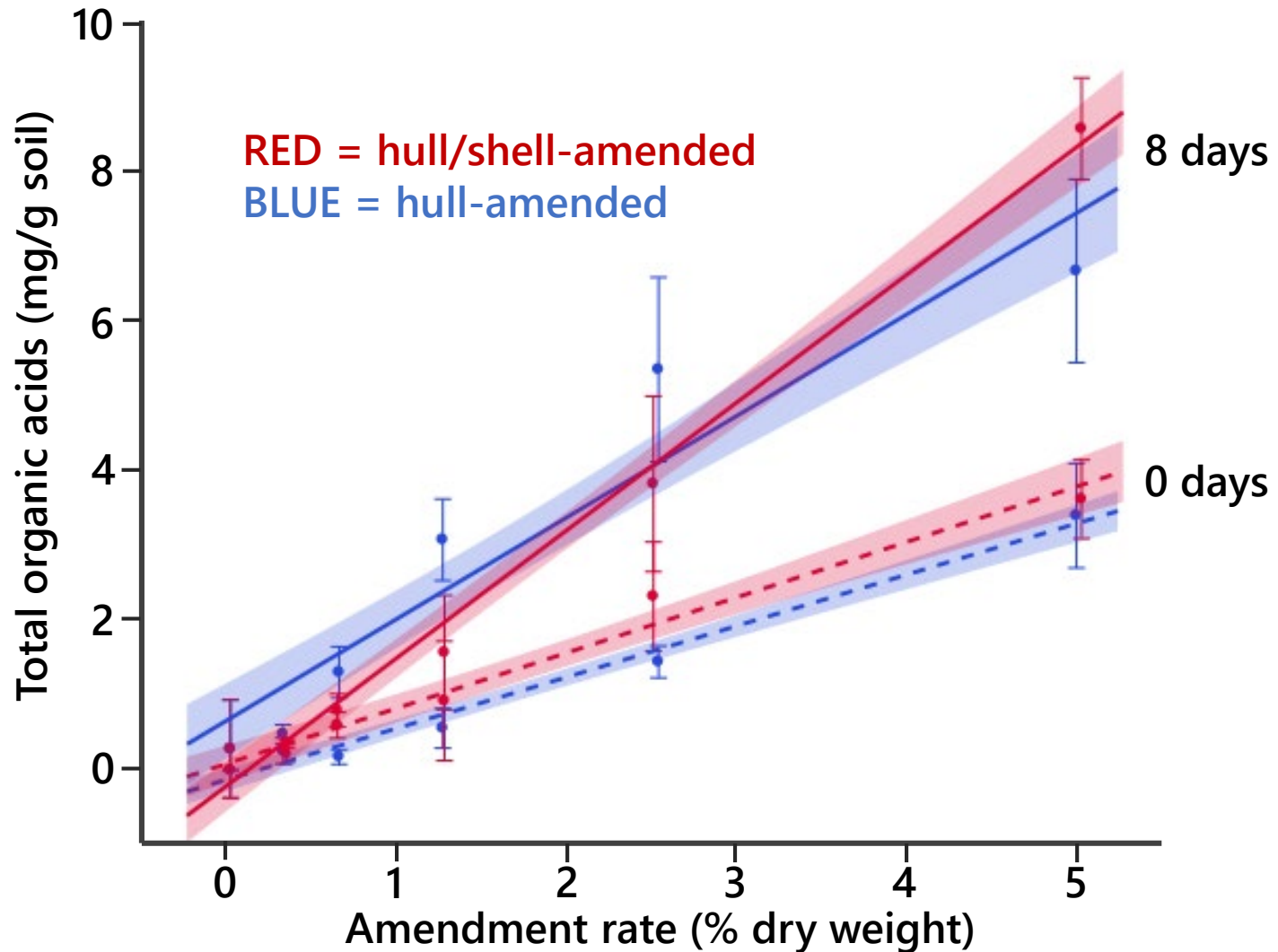
Measure and increase grower awareness of biosolarization



Interfacing with the CA almond industry



Hull- and hull/shell mix-amendments lead to accumulation of organic acids in the soil



Endogenous organic acids on almond residues provide immediate acidification of the soil, which may improve pest inactivation kinetics.

Root lesion nematode (*Pratylenchus* spp.) inactivation

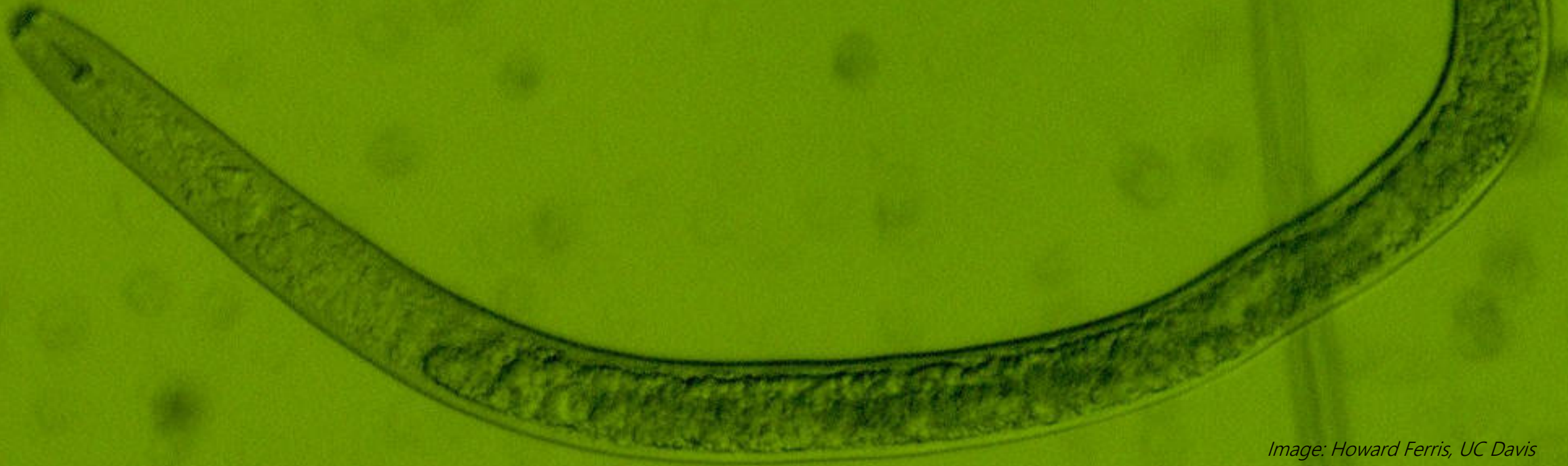
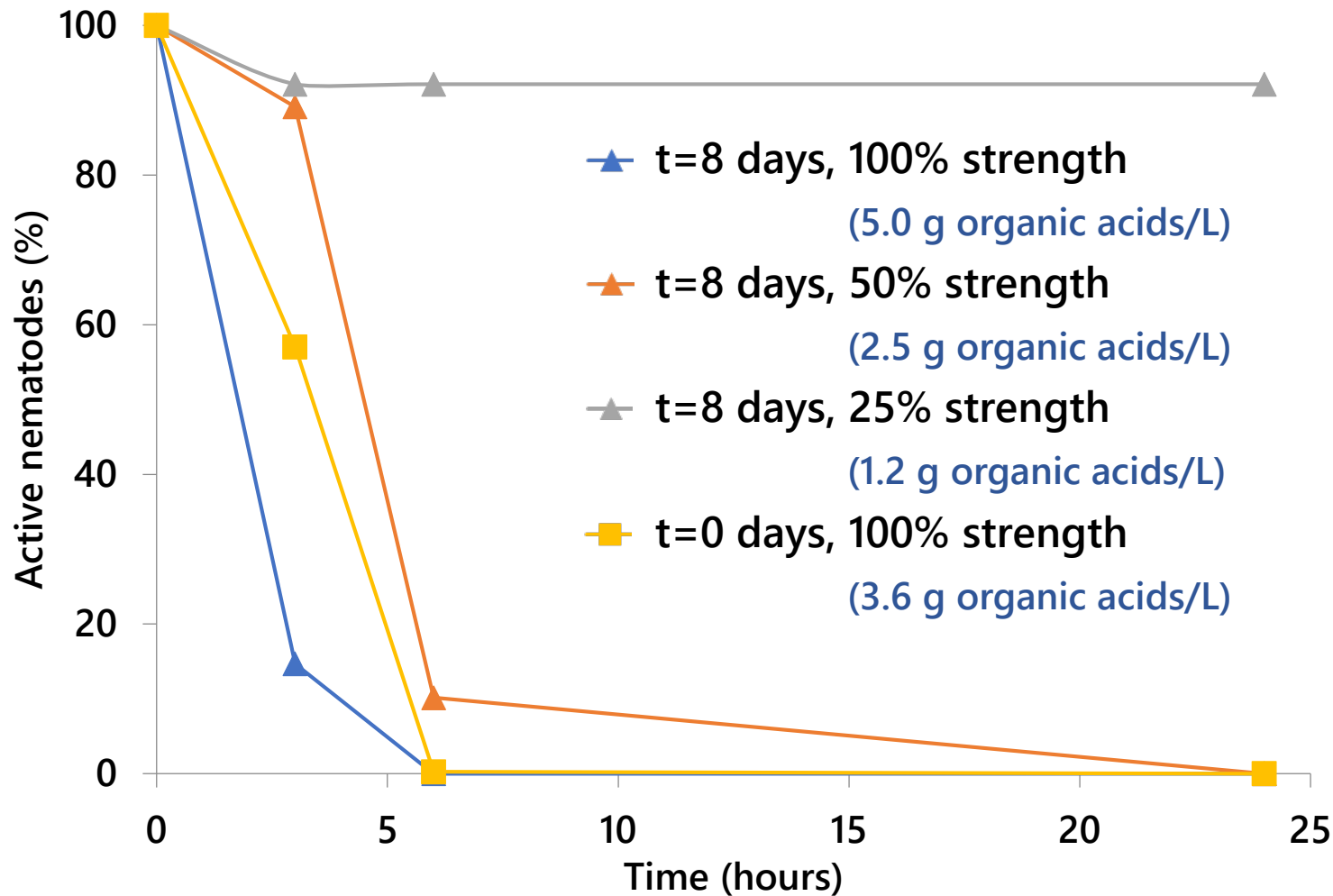


Image: Howard Ferris, UC Davis

Extracts from amended soils exhibit robust nematocidal activity



- Soil amended with nonpareil hulls (5% dw).
- Aqueous extracts taken immediately after amendment and after 8 days of anaerobic incubation.

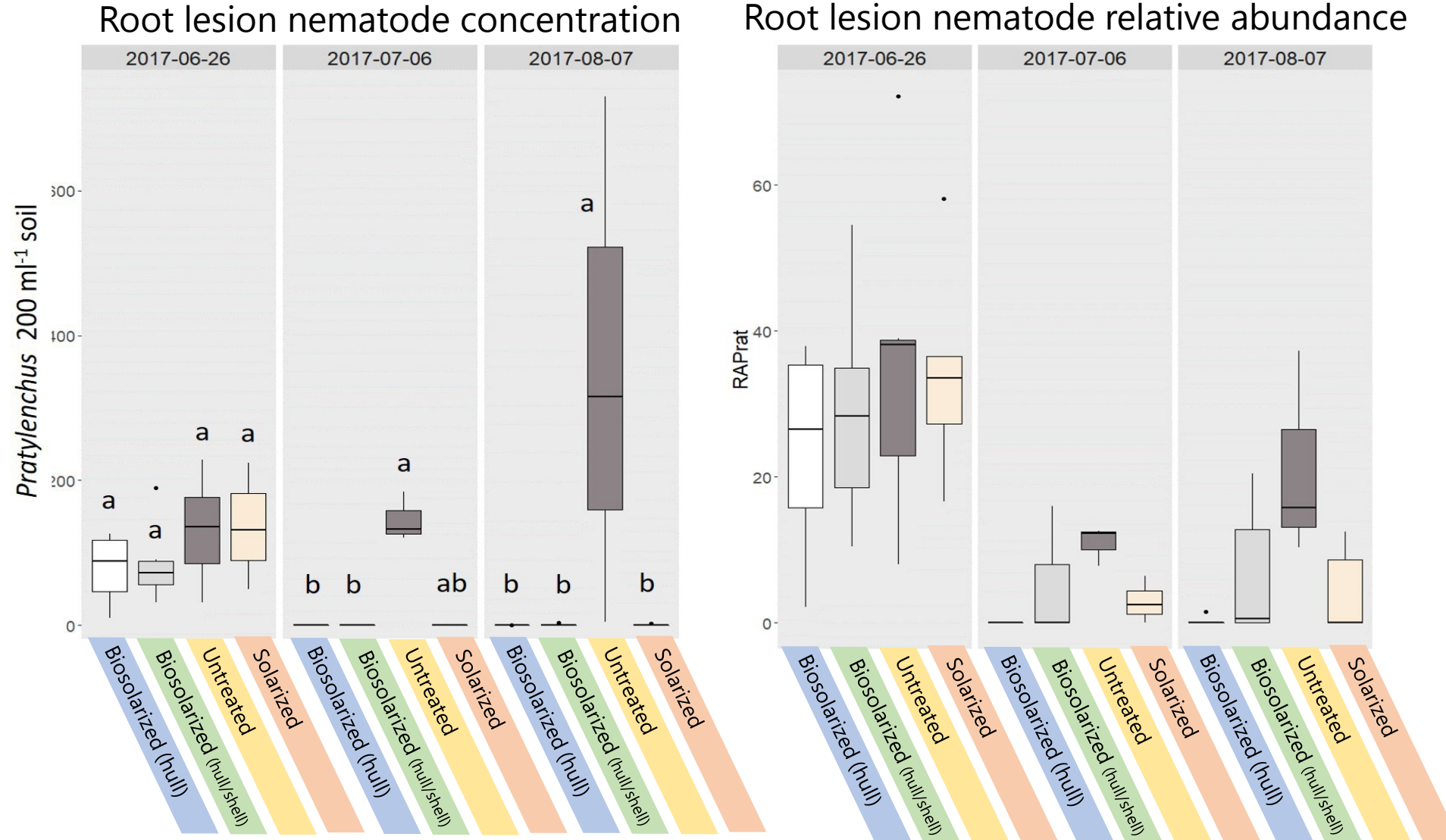
Impact

An aerial photograph of a large agricultural field. The field is divided into several sections. On the left, there is a long, narrow strip of young, green trees. To the right of this strip is a large, rectangular area of brown soil, which is the field trial. This area is marked with numerous parallel, light-colored lines, likely representing different experimental treatments. Further to the right, there is another section of the field with rows of mature, green trees. In the background, there is a line of trees and some buildings, suggesting a rural or semi-rural setting. The sky is clear and blue.

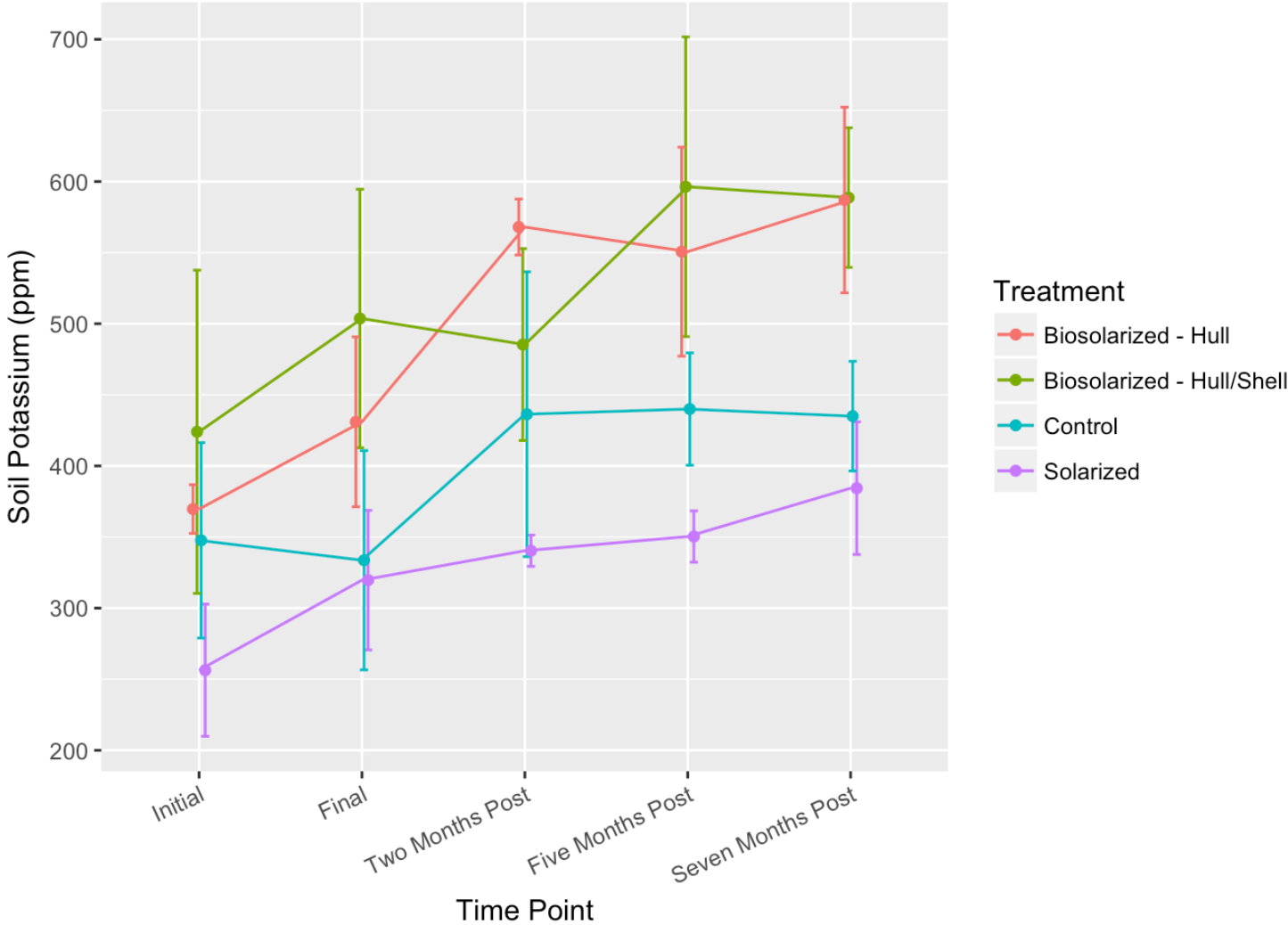
~10 acre field trial with
the Nicolaus Nut Co. in Chico, CA

Additional support from the Almond Board of California

Root lesion nematodes were controlled in solarized and biosolarized soils



Biosolarization amendments can introduce plant nutrients to the soil



A complex array of volatile compounds are produced during biosolarization

COMPOUND	PROPERTIES	PROMINENCE
Isoamyl Alcohol	<ul style="list-style-type: none"> •Anti-fungal •Starch fermentation by-product •unpleasant odor, irritant at 150 ppm 	Small constituent of volatiles from hull amended samples ~ 1 %
2-Butanone	<ul style="list-style-type: none"> •Natural product: fruits, veggies, trees •PEL 200 ppm 8 hr 	Medial constituent of volatiles from hull amended samples ~ 5-10
2-Pentanone	<ul style="list-style-type: none"> •plants and apple •PEL 200 ppm 8 hr 	Medial constituent of volatiles from hull amended samples ~ 5-10
Diacetyl	<ul style="list-style-type: none"> •secondary or malolactic fermentation •"popcorn workers lung", PEL 8 hr 0.01 ppm 	Large constituent of volatiles from hull amended samples ~ 10 %
Acetoin	<ul style="list-style-type: none"> •product of microbial fermentation •Antimicrobial •Plant - growth promoting •Oxidizes to diacetyl on exposure to air. 	Very large constituent of volatiles from hull amended samples ~ 20 %
phenylethyl alcohol	<ul style="list-style-type: none"> •found in almond •Saccharomyces cerevisiae, plant, aspergillus metabolite •antimicrobial, antiseptic •plant growth retardant 	Small constituent of volatiles from hull amended samples ~ 1 %



Ongoing work

- Almond yield effects
- Effects on additional crops
- Exposure risk reduction
- Grower outreach

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**Western Center for
Agricultural Health
and Safety**

