Soil Health and Ecosystem Management Minimize Pest and Disease Problems

Gerald Davis – CCA Agronomist

Retired Cal Organic/Grimmway Farms

Crop and Farming Experiences

Owner and operator of 5 acre Organic vegetable direct market operation in Tehachapi, CA (Est. 2019)

Crop and Farming Experiences

30 years experience in pest control and agronomy for a large acreage, multi-region, certified organic vegetable operation.

Regional Experiences

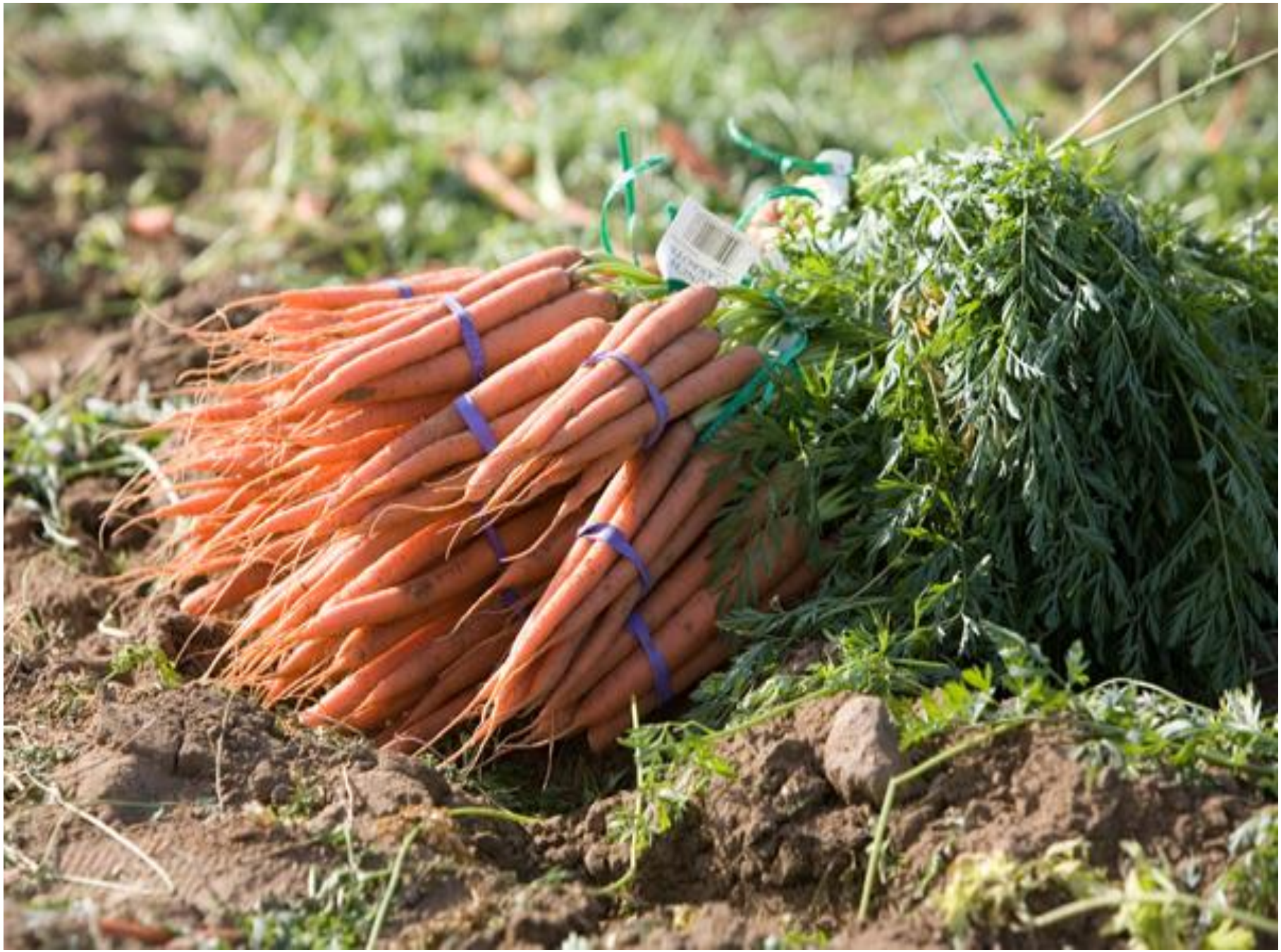
Central and Southern California

Washington

Tri-Cities Area

Colorado

San Luis Valley



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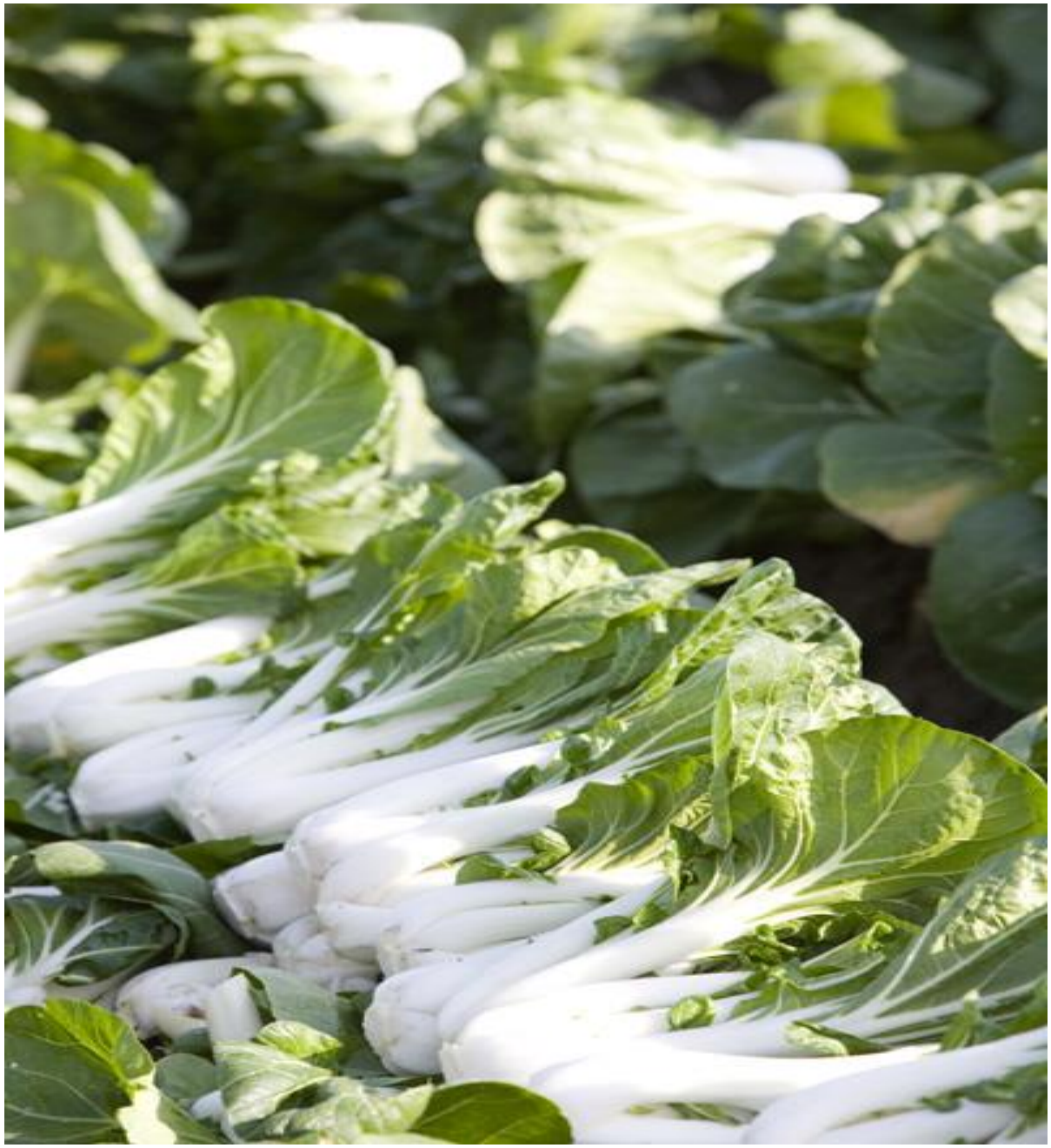
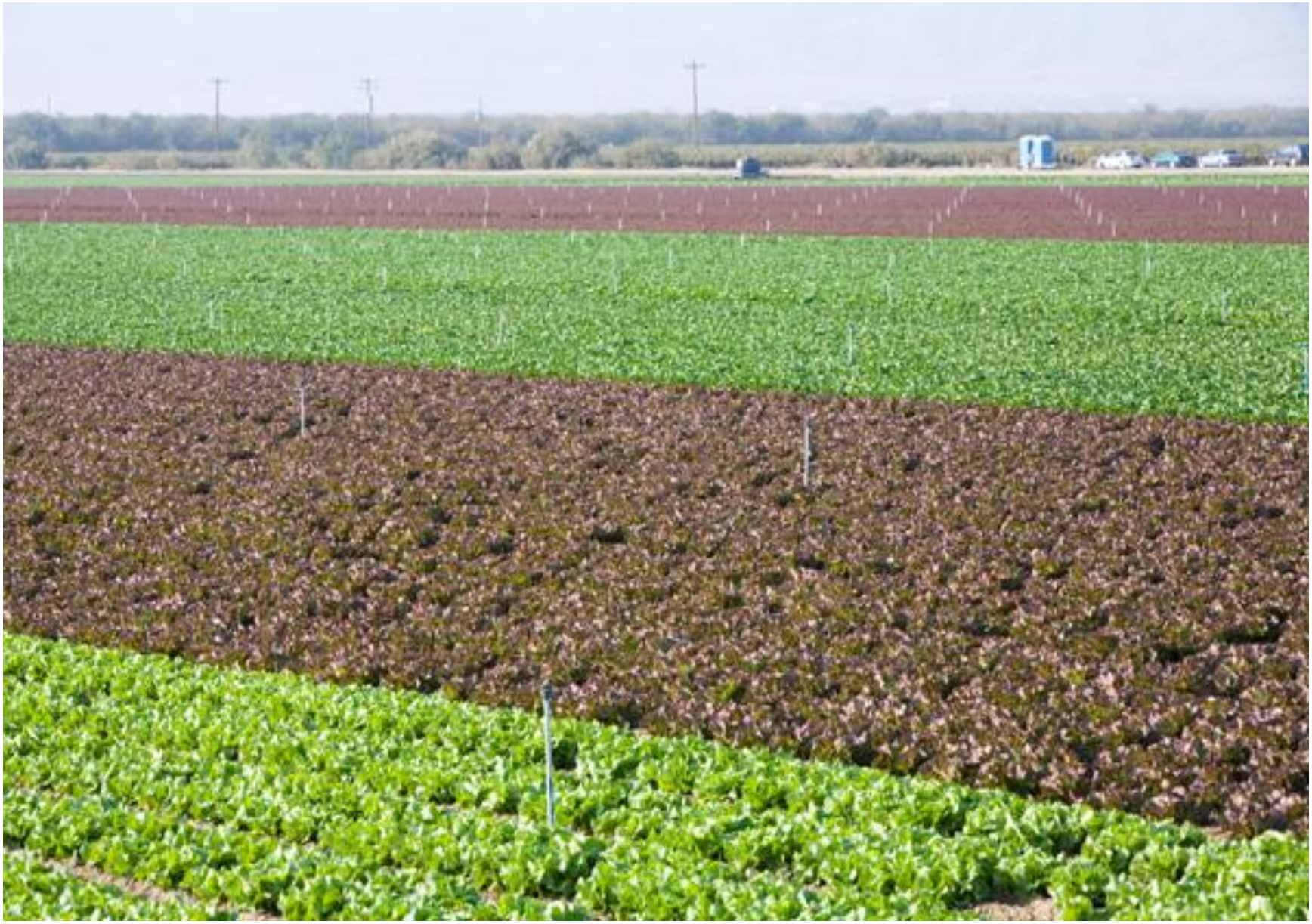
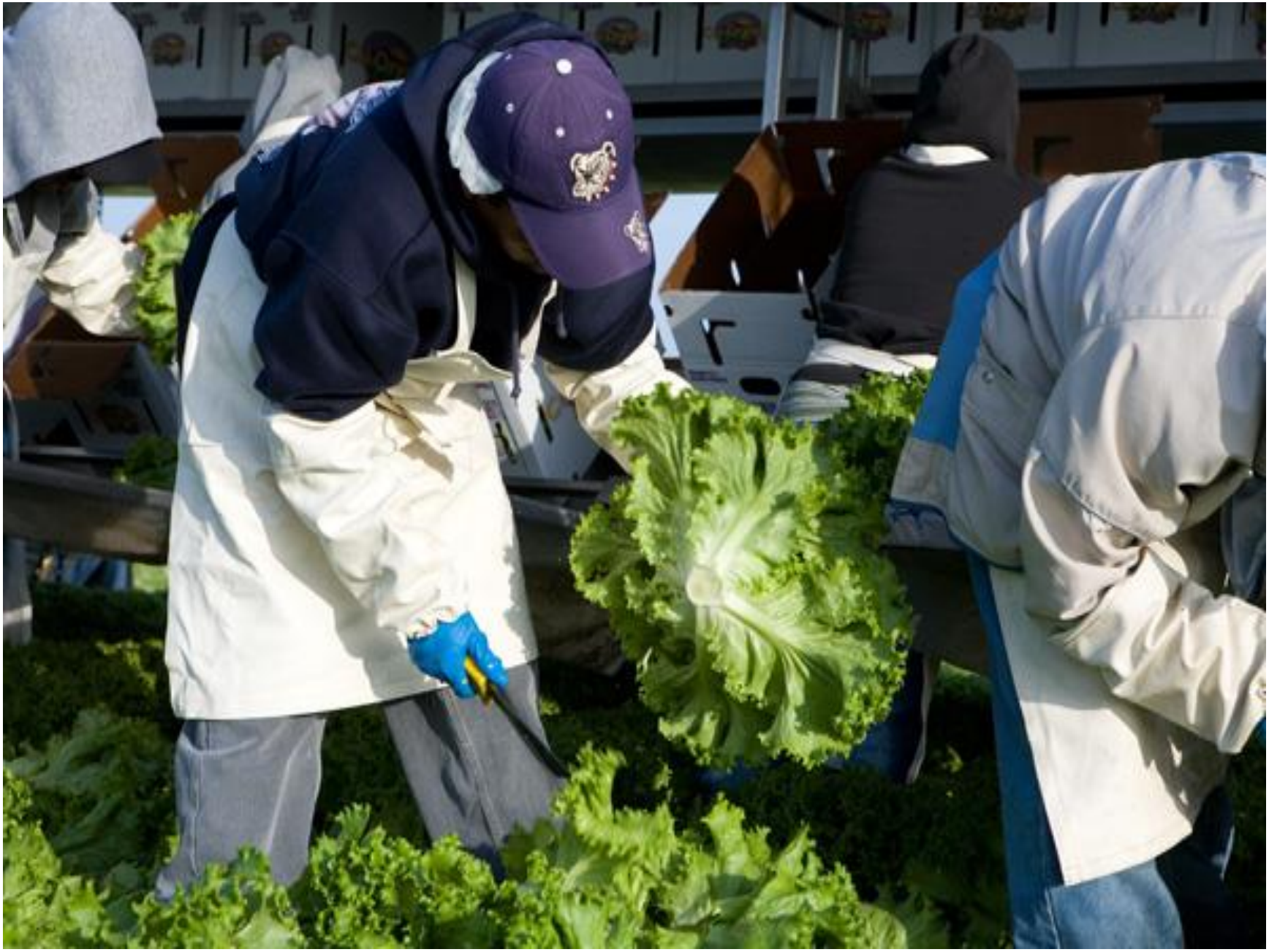
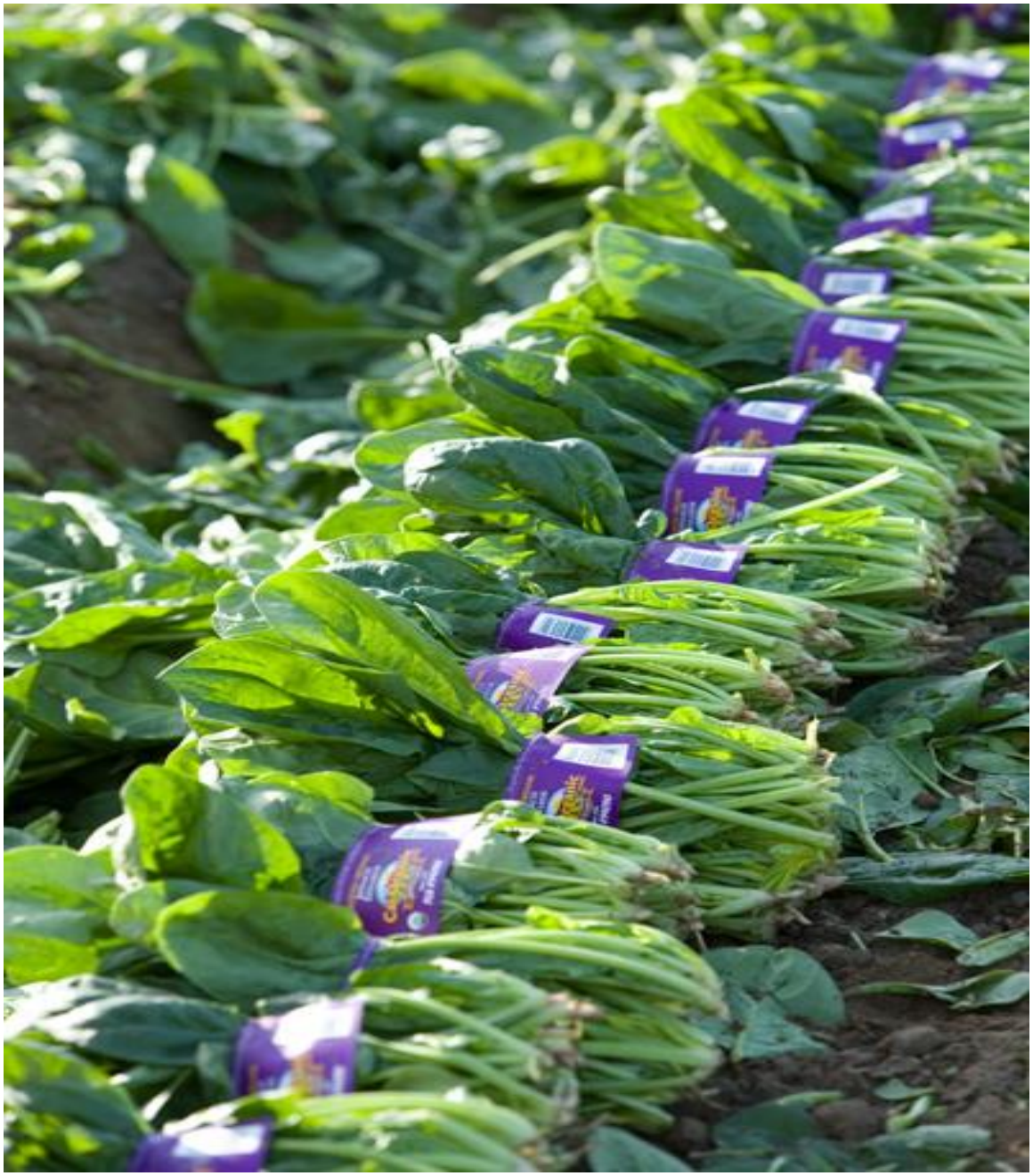
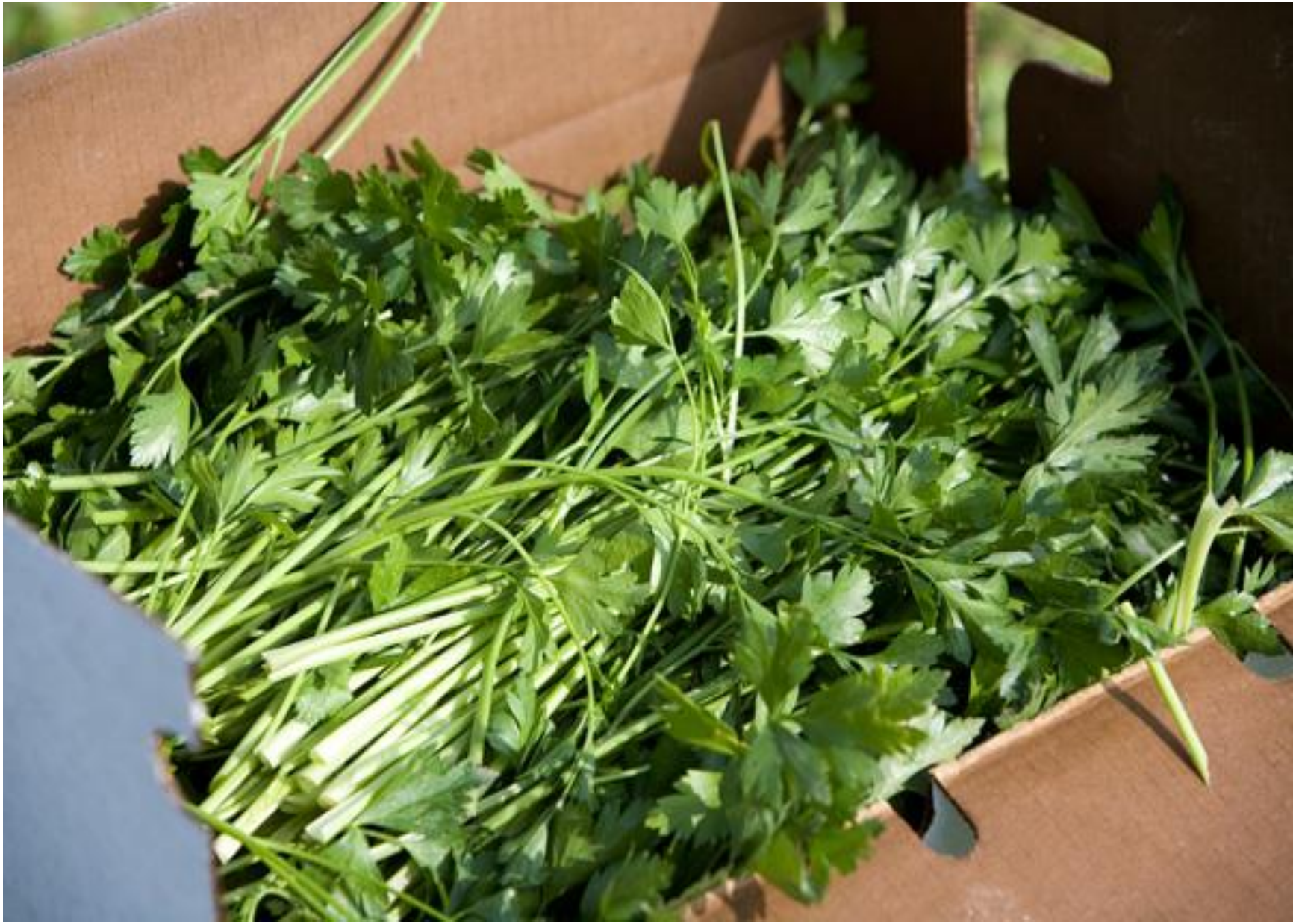
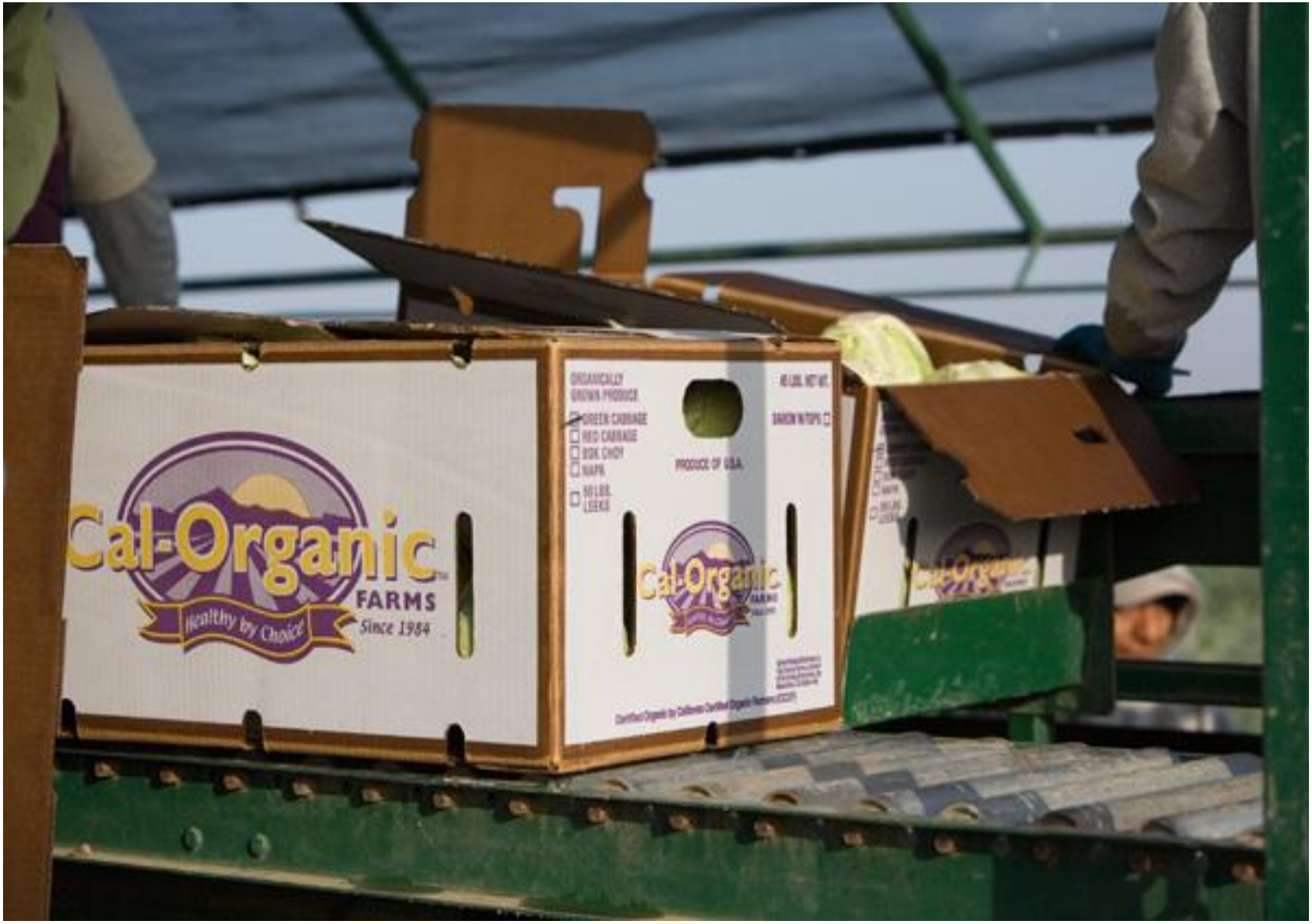











Cal-Organic
FARMS
Healthy by Choice
Since 1984
ORGANICALLY
GROWN PRODUCE
GREEN CABBAGE
RED CABBAGE
BOK CHOY
NAPA
LEEKS
PRODUCE OF U.S.A.
Cal-Organic

National Organic Standards Board (NOSB)

-15 members appointed for 5 year terms by the Secretary of Agriculture

- Made up of individuals from a variety of fields involved with organic production, handling, certification, as well as consumer and environmental advocacy.

Healthy, disease suppressive soils are the product of a robust biological ecosystem

- Which is supported by living plant roots kept in play for as much of time as possible
- Aided greatly by minimized soil disturbance (tillage or chemical intrusion)
- Supported to a lesser degree by the physical and mineral makeup of the soil

Examples: The mineral makeup of soil impacting soil disease incidence

- Soils that have poor flocculation due to poorly balanced cation ratios
- Flocculation being the microscopic clumping of soil in a particle arrangement that allows for better air and water space
- Divalent cations (Calcium and magnesium) flocculate soil (not dispersed)
- Monovalent cations (potassium, sodium) de-flocculate or disperse soil

Examples: The mineral makeup of soil impacting soil disease incidence

- Deflocculated (dispersed) soil have poorer air/water spaces
- Leading to slower water percolation following irrigation events and prolonged saturation period
- Which hinders the roots' ability to get optimal oxygen and favors certain soil pathogens, i.e. Pythium, ability to overcome plant resistance
- Carrots grown in such soil succumb to Pythium violae (cavity spot) much more readily

P. violae on carrot

The tendency of lesions occurring near soil surface indicates impaired water percolation at that level

DATE	Field	K	K Soln	Ca	Ca soln	Mg	Mg soln	Ca:Mg Ratio	Na	Na Soln	% Ca	% Mg	% K	% Na
11/5/2023	MX	530	74	2,204	101	143	18.5	15.4	85	65	79	8.6	9.8	2.6
9/27/2023	KV	532	205	2,132	773	142	112.0	15	104	104	78	8.7	10	3.3
9/13/2023	BN	658	67	4,530	365	262	57.2	17.3	357	185	80.7	7.8	6	5.5

Healthy, disease suppressive soils are the product of a robust biological ecosystem

- Aided greatly by minimized soil disturbance (tillage or chemical intrusion)
- Left completely undisturbed and not treated with chemicals, such as in organic pasture or orchard crops, the bacteria and fungi proliferate and create aggregated soil structure over time

Healthy, disease suppressive soils are the product of a robust biological ecosystem

- When the adoption of No-Till management is not an option for a farm, building stable soil aggregates would be somewhat unattainable
- Examples of attainable soil health improvement practices

Examples of attainable soil health improvement practices

- Eliminating plowing that inverts soil layers improves the chances of resurgence of mycorrhizal fungi
- Soil ripping and shallow harrowing
- Inoculation with available mycorrhizal products

Examples of attainable soil health improvement practices

- Inoculation with available mycorrhizal products
- As a sidelight here, augmenting biocontrol in soil with compost teas can be effective in suppressing pathogens
- Mass inundation with organisms from the tea can interfere with pathogen infection

Common potato scab

In-furrow mass inundation biological treatments at planting can almost eliminate this problem

Examples of attainable soil health improvement practices

- Eliminating plowing that inverts soil layers improves the chances of resurgence of other fungal and bacterial species
- Soil ripping and shallow harrowing can leave the 4-10” soil zone somewhat less disrupted
- This allows for greater abundance and more diversity of organisms than inversion tillage schemes

Examples of attainable soil health improvement practices

- Addition of cover crop green manures and composted animal manures support this greater abundance and more diversity of organisms
- An indirect measure of this increased abundance can be evidenced by testing for bacterial/fungal feeding nematodes, often offered with parasitic nematode tests

Examples of attainable soil health improvement practices

- In 30 years I have nematode tested many thousands of conventional farm acres being transitioned to certified organic
- Root-knot nematode presence is commonly detected in the first-year tests along with low levels of bacterial/fungal nematodes (<0.5 nematodes/g soil)

Examples of attainable soil health improvement practices

- After 1-2 cover crop green manure applications and the initial composted animal manure prior to organic cropping, further nematode testing is conducted
- Test results show ↑ bacterial/fungal feeders and ↓ root-knot nematodes(RKN)
- Within 5 years of organic transition, RKN disappear, bact./fungal feeders 1-2/g soil

Examples of attainable soil health improvement practices

- Population increases in bacterial/fungal feeding nematodes are an indicator of population increases in their prey.
- Within the RKN life cycle, the sedentary egg sac stage would be most susceptible to bacterial attack compared to motile form
- Highly motile nematodes such as Paratrichodorus and Longidorus maintain populations

Measuring soil health factors

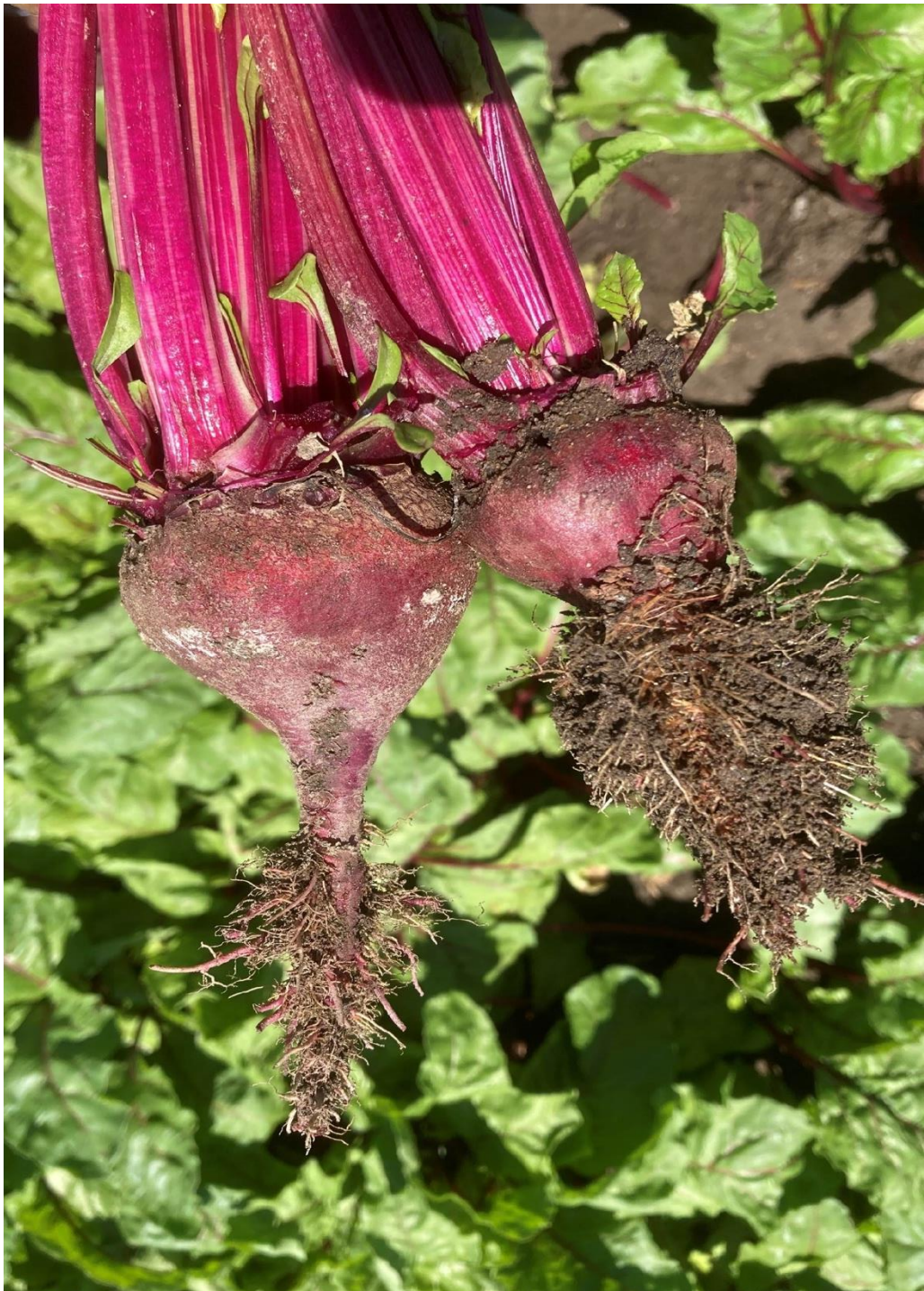
- Very difficult to accurately quantify 20+ years ago
- Had to evaluate largely by inference based on crop performance results
- Improvements in genetic testing technology bringing much better information

Reducing disease inoculum levels

- A big role in improving soil health
- Effective crop rotations disrupt increases in disease inoculum
- This includes long rotations(5+ years) between some crops- Onions, garlic, beets
- Consider that back-to-back crops within the same plant family will most likely build disease inoculum

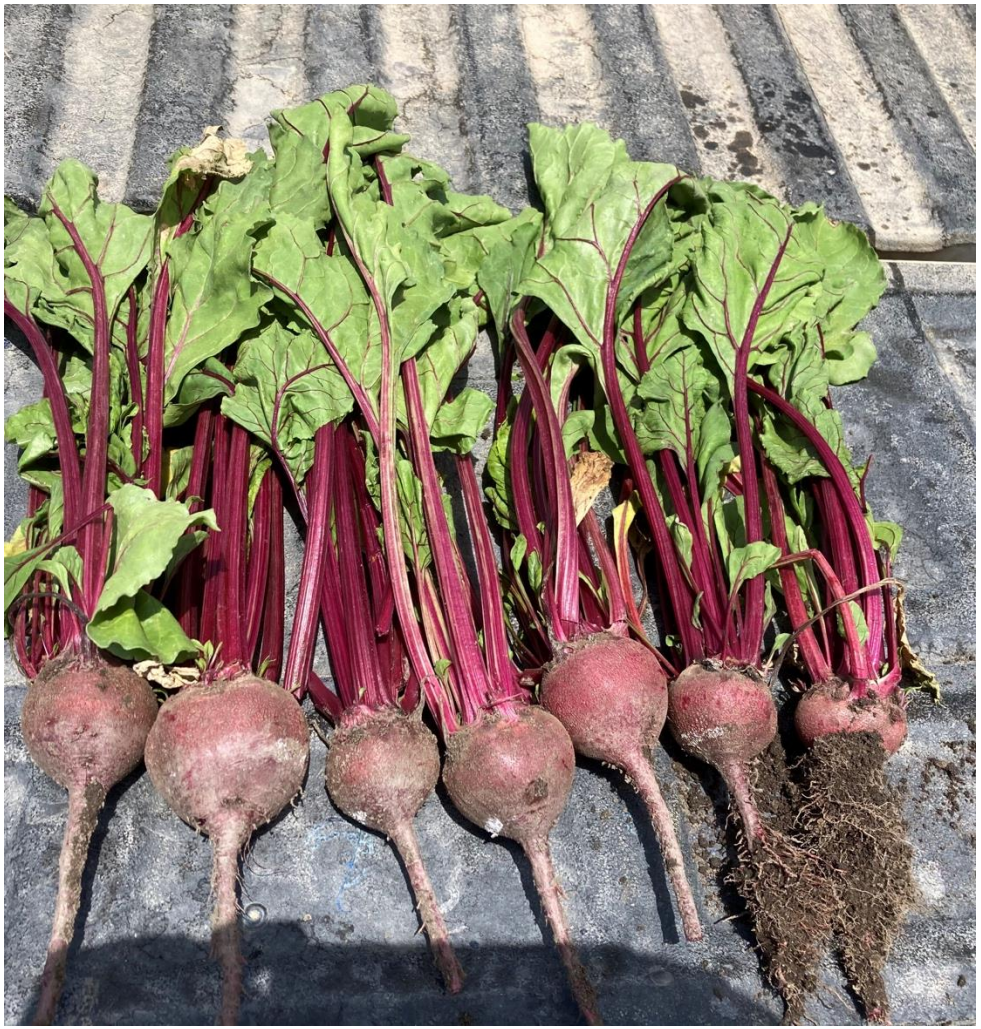
Rhizomania in beets

Very long rotation intervals are needed to avoid this



Rhizomania in beets

Very high infection rates in affected fields



Healthy, disease suppressive soils are the product of a robust biological ecosystem

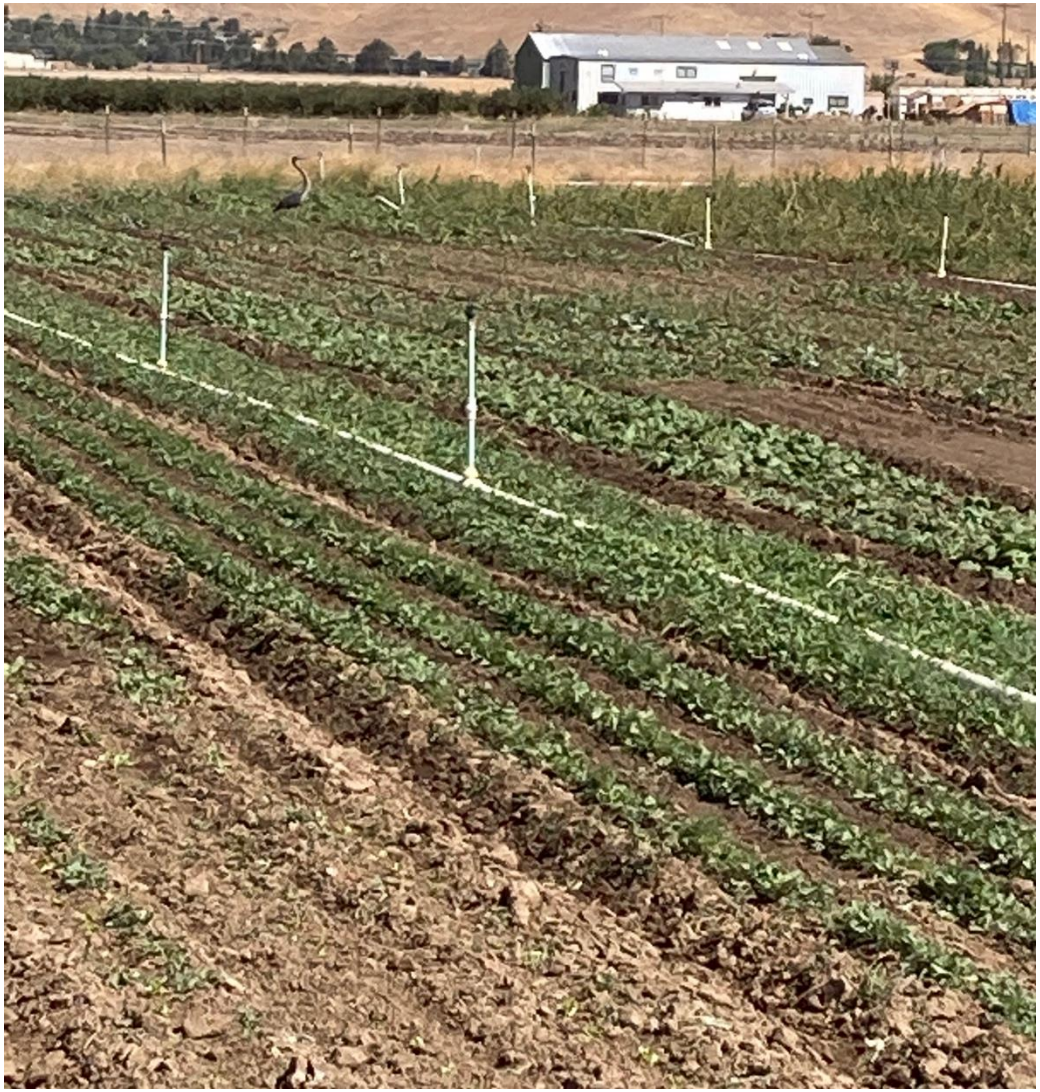
- When the adoption of No-Till management is not an option for a farm, re-building stable soil aggregates would be somewhat unattainable
- But, stable aggregates can be maintained in a reduced tillage system

Stable soil aggregates

Sunergeo Farm
Tehachapi, CA

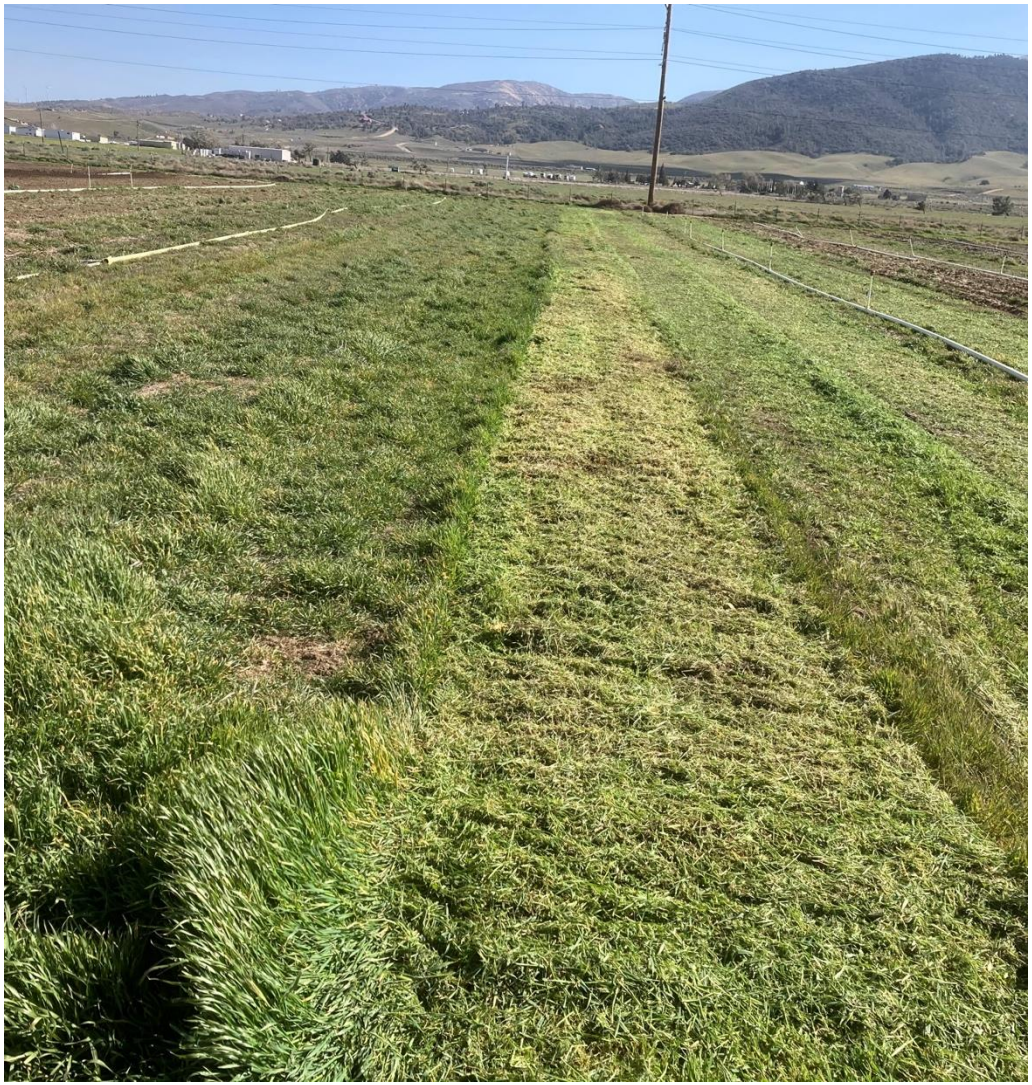
Permanent bed system

Note the hunter helper in the background



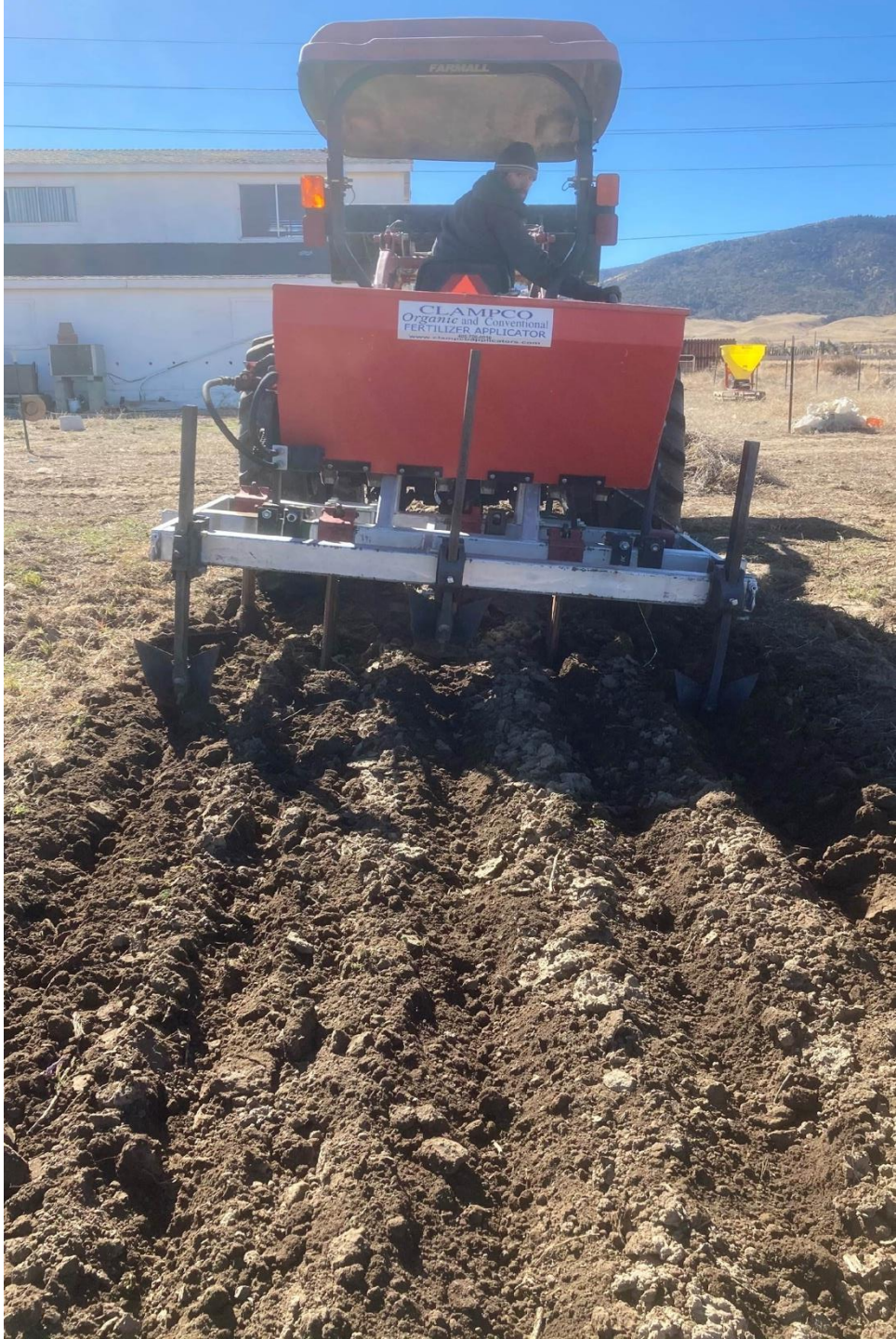
Permanent bed system

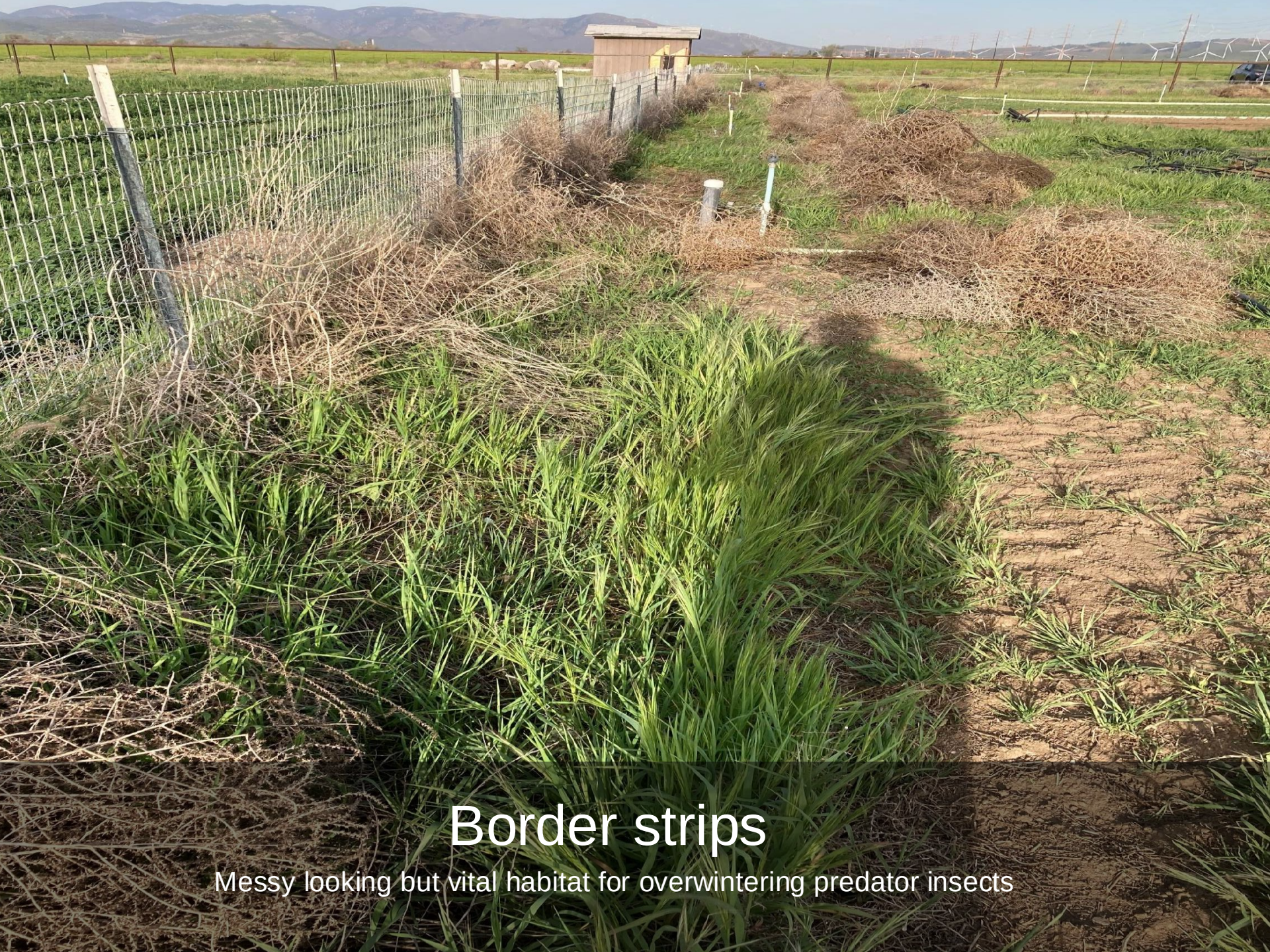
Grasses and weeds provide roots in off-season for sustaining soil biology



Bed ripping

Three shanks per 60” bed at 8-10” depth





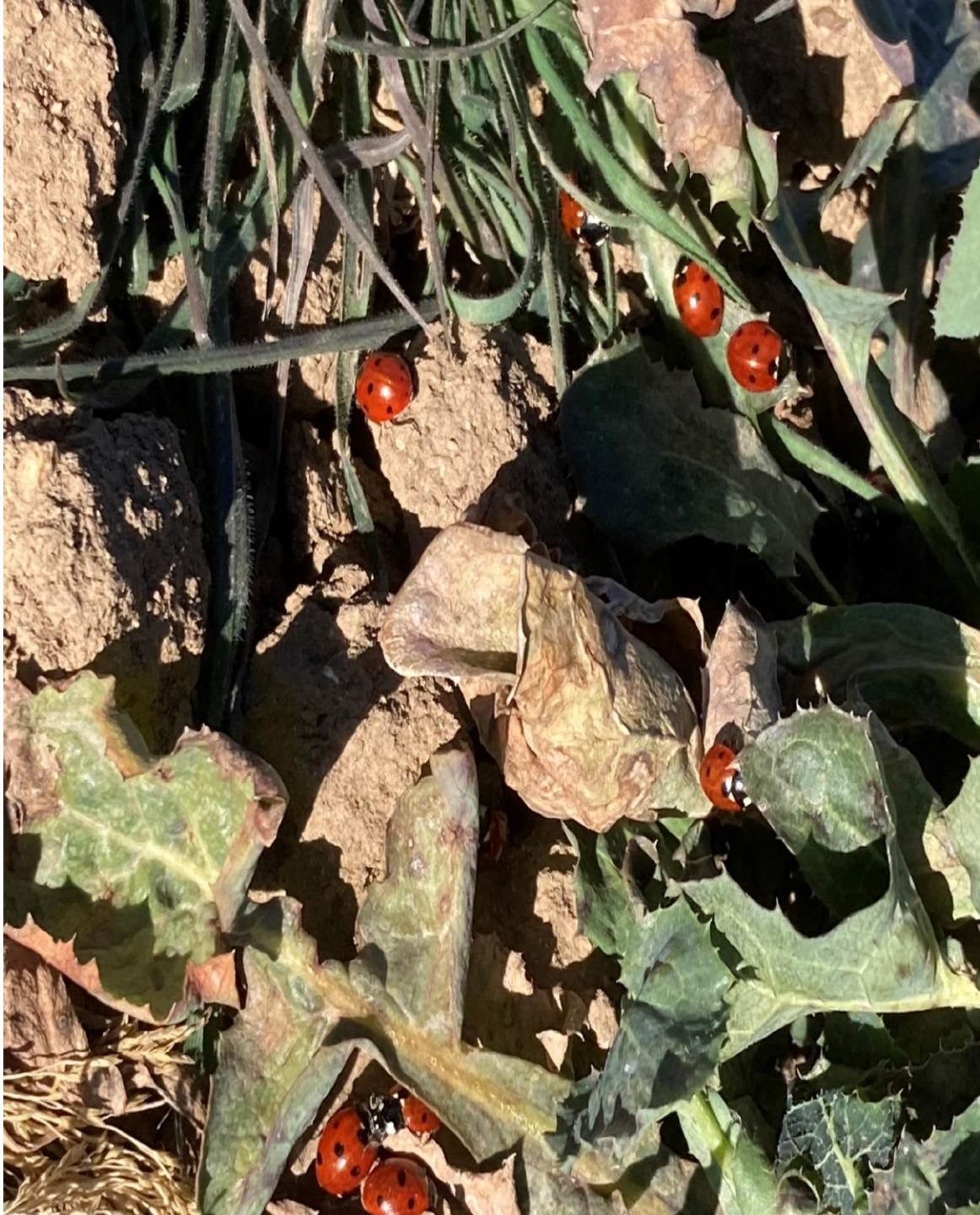
Border strips

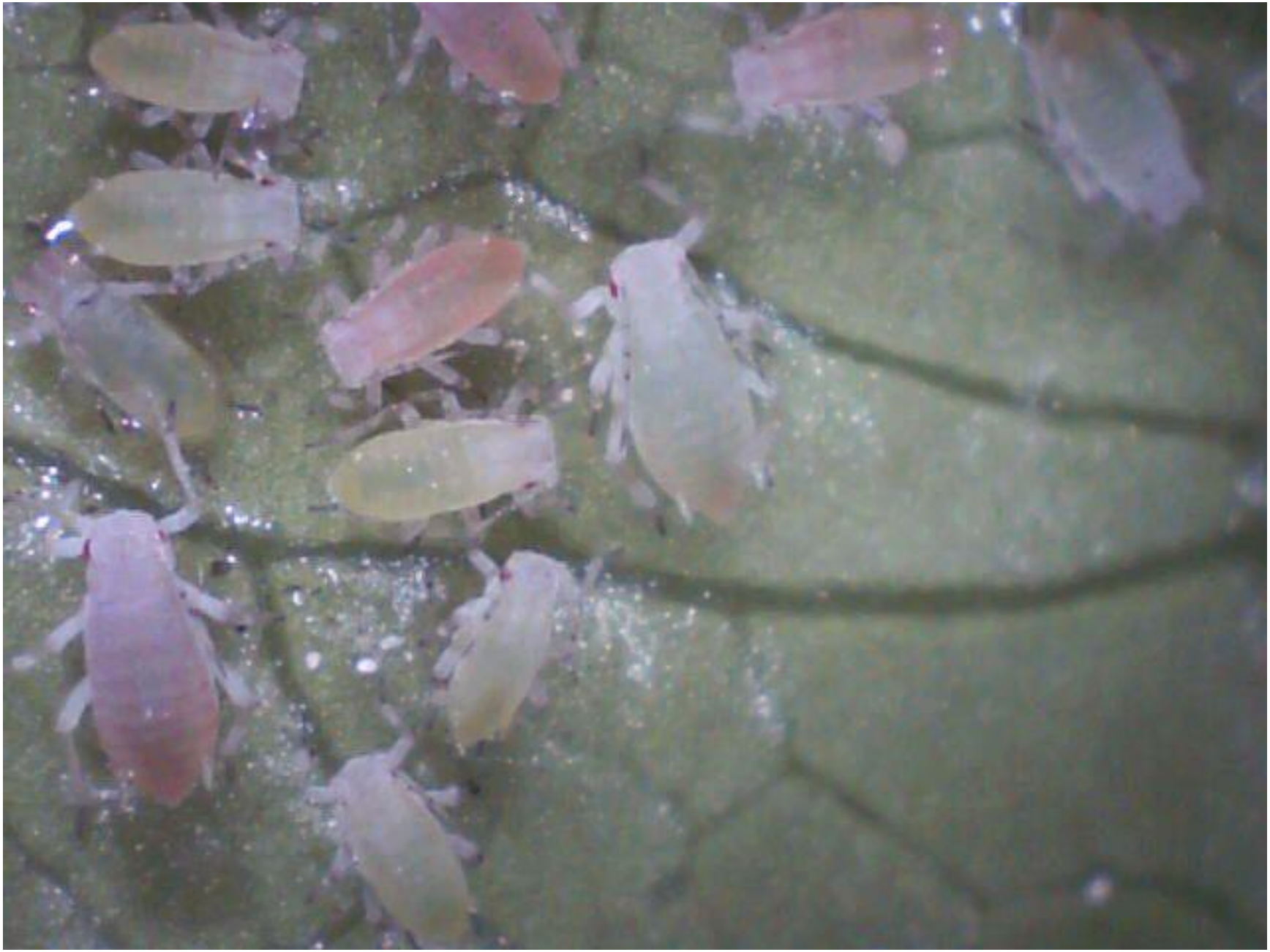
Messy looking but vital habitat for overwintering predator insects

Overwintering ladybugs

Feeding on various lettuce aphid types on sowthistle weeds

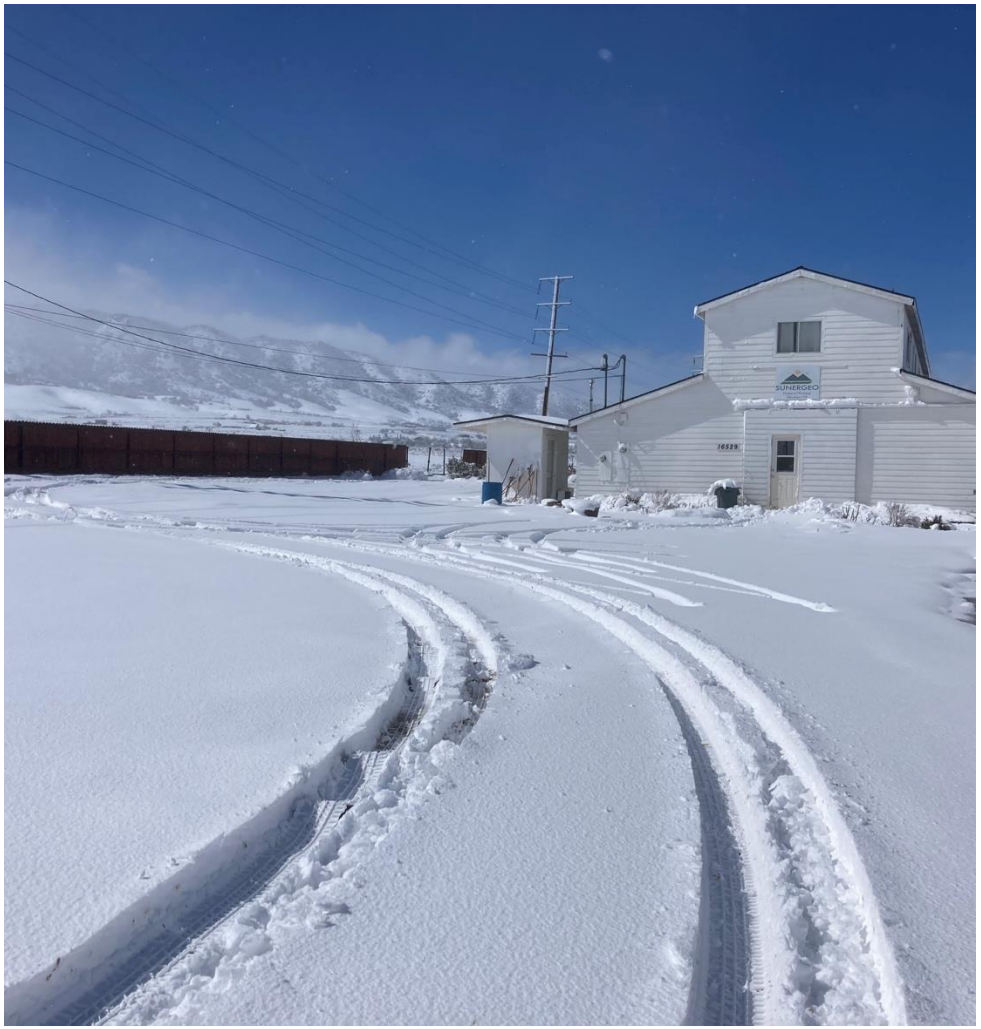
Mustard weeds provide cabbage aphid food supply as well





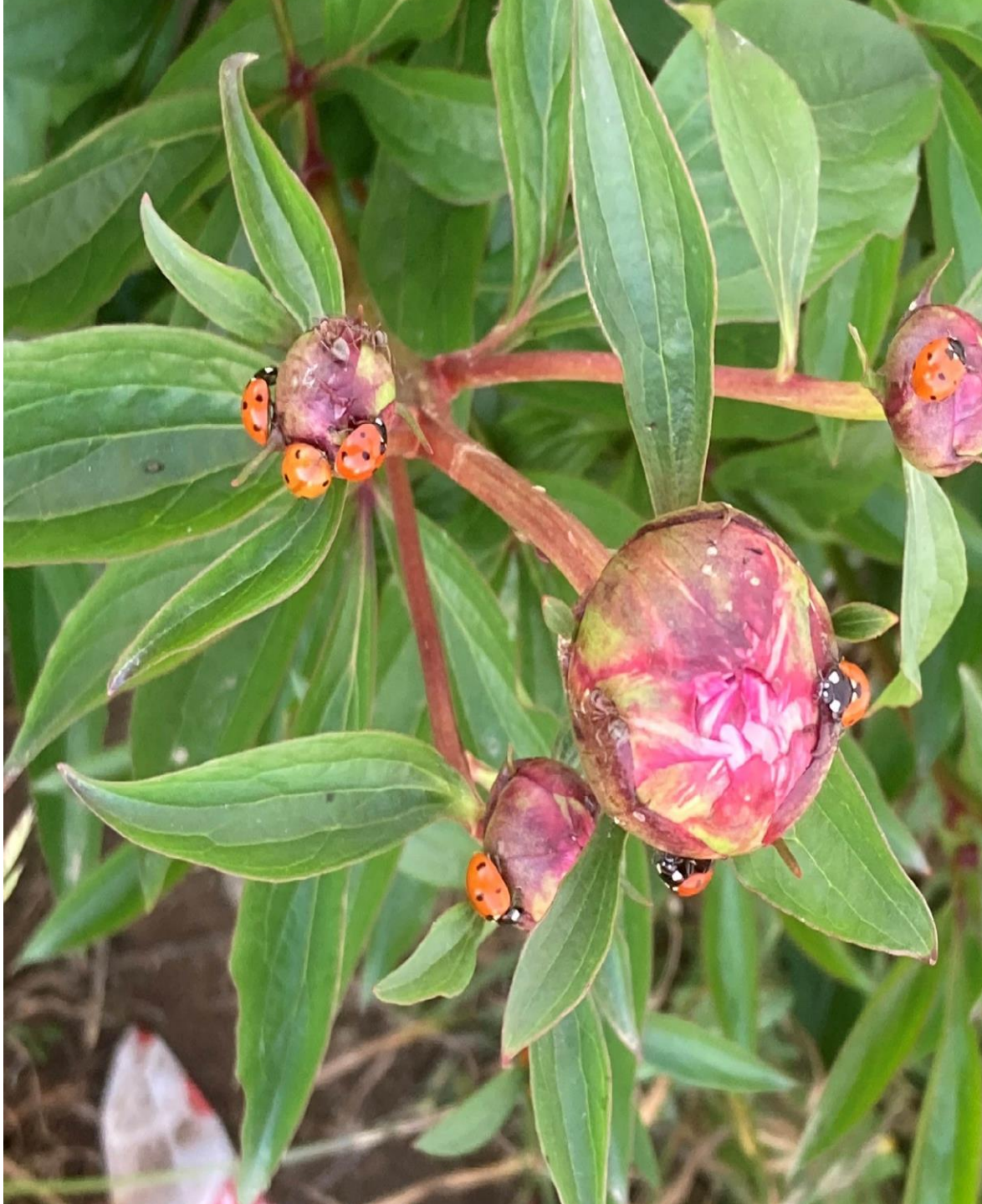
Winter

Weed cover for predators much appreciated



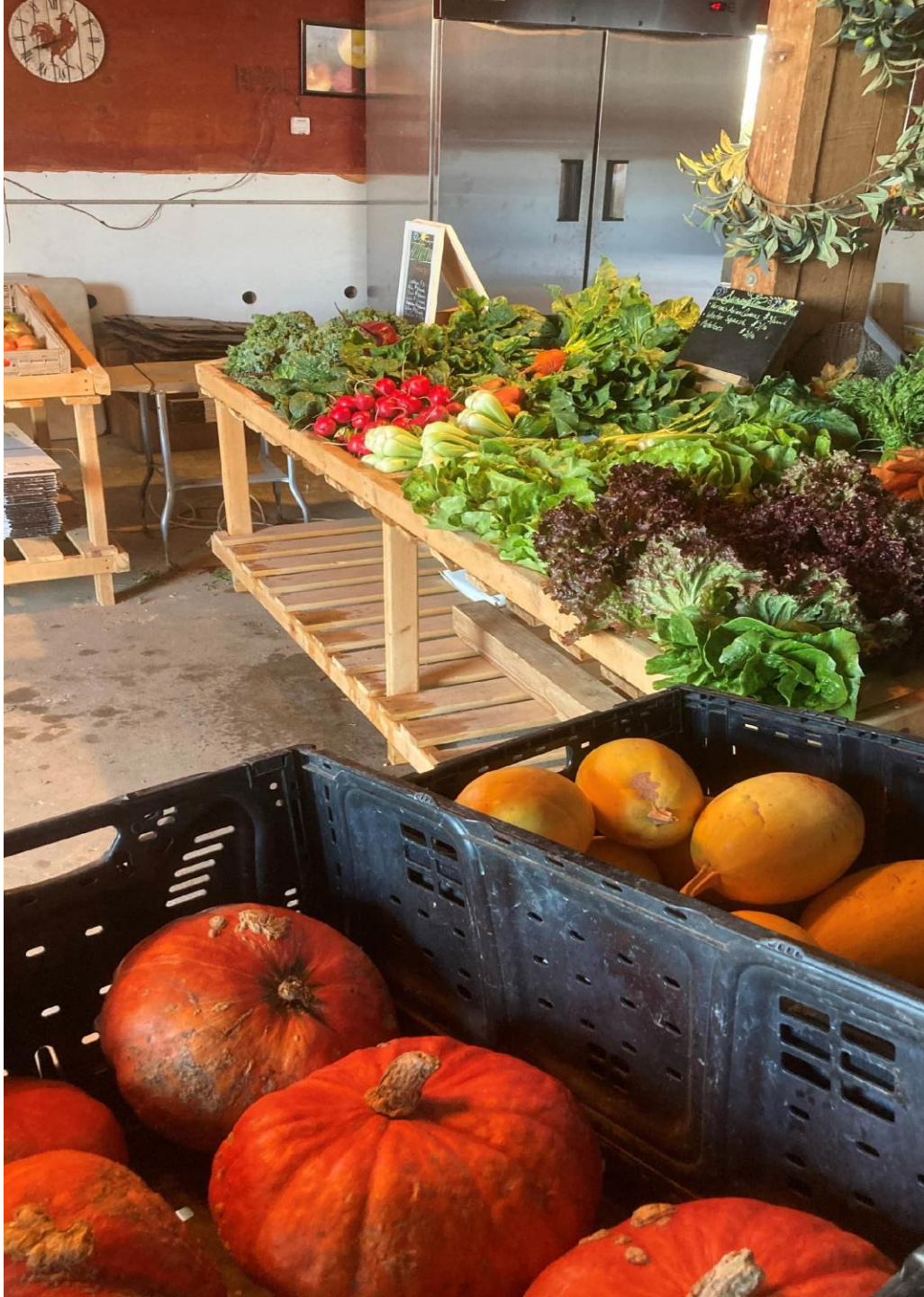
Peony flowers

Note the presence of ants trying in vain to guard their ant herd



Farmstore

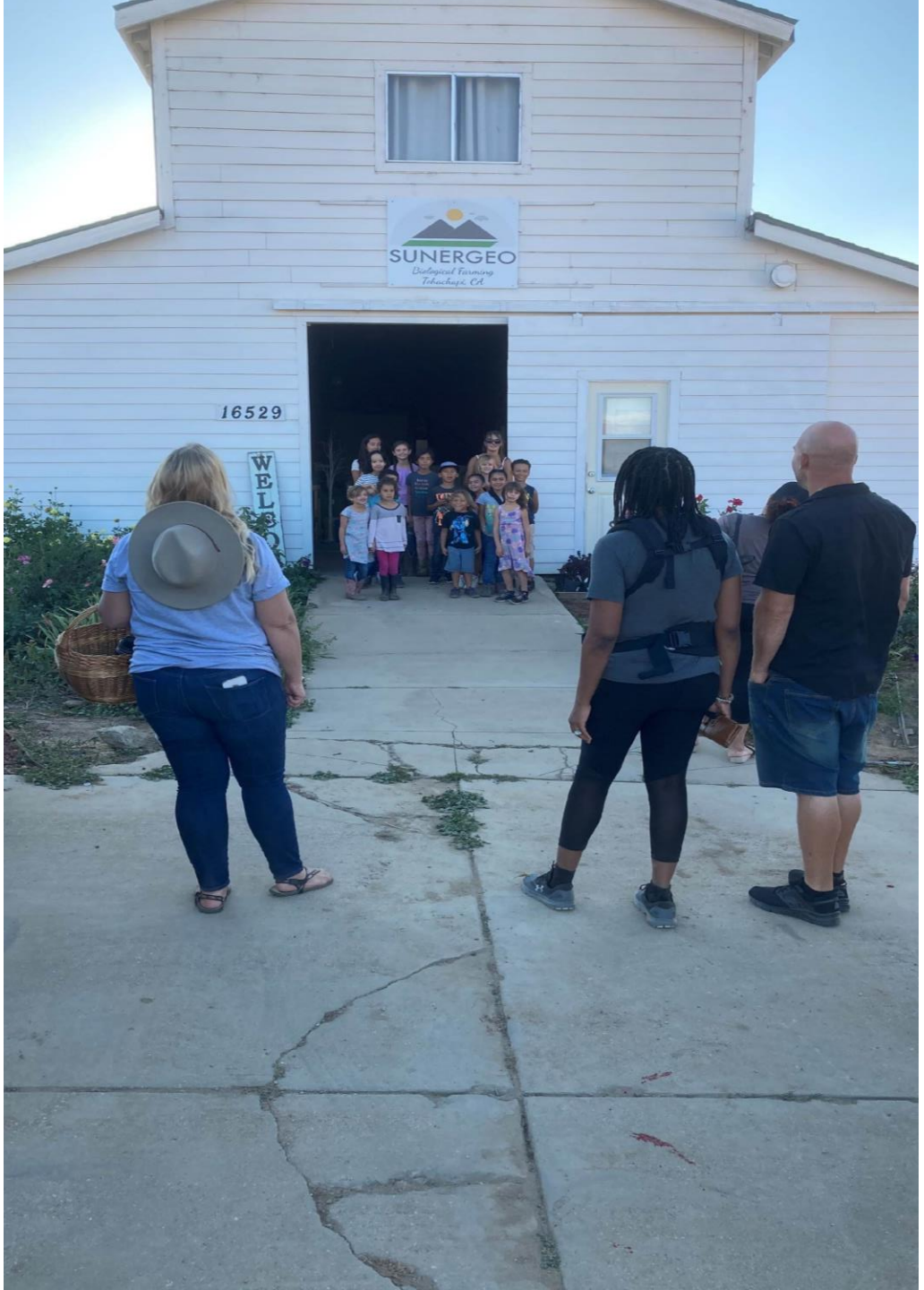
Sunergeo Farm



Sunergeo Biological Farming

Tehachapi, CA

sunergeofarm.com




Questions?