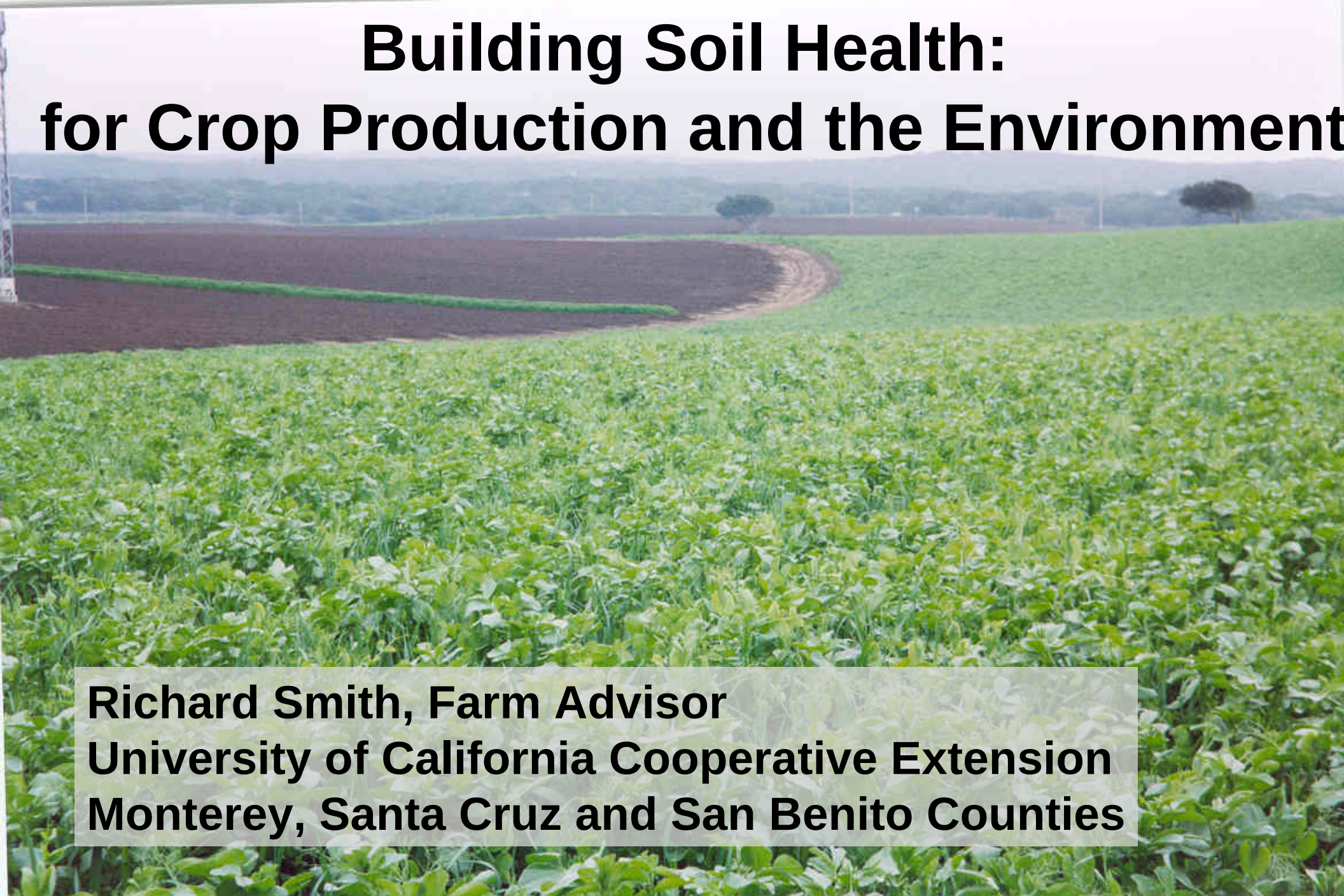
Building Soil Health:
for Crop Production and the Environment



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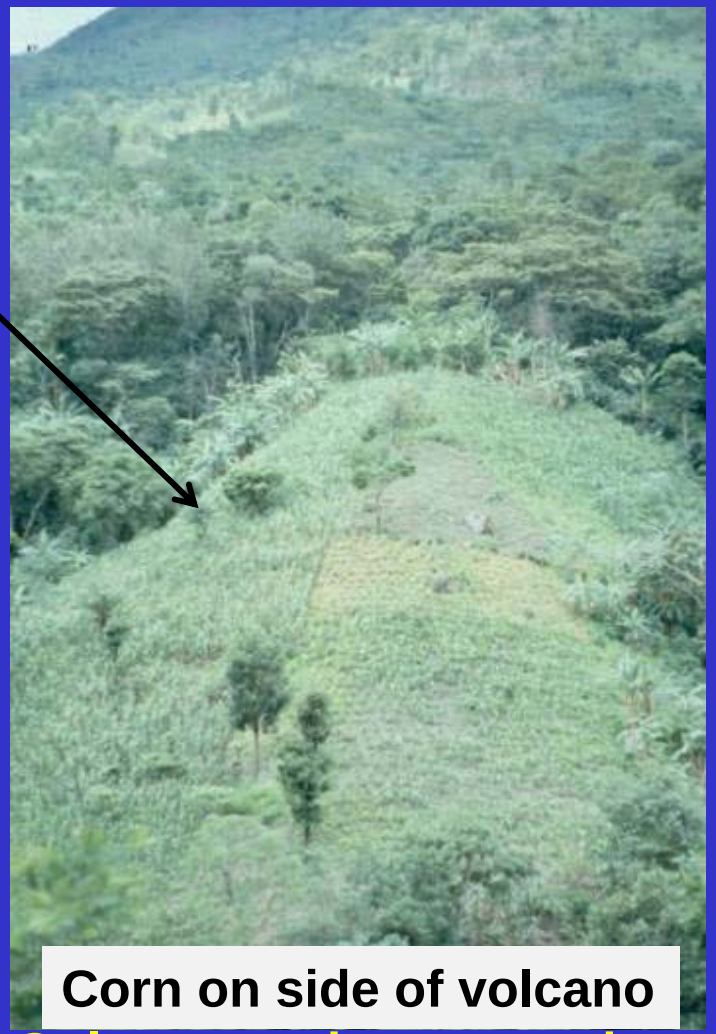
How do We Achieve Healthy Soil?

Creating Healthy Soil

- Cannot Change
  - Texture, slope, depth
- Can Change
  - Structure (tilth, aeration, infiltration, macropores)
  - Nutrient content and holding capacity
  - Drainage (internal drainage & subsoil)
  - Organic matter content & microbial activity



Corn on side of volcano

Only so much you can do….

How do We Improve Soil Health

- Additions of organic matter
  - Crop residues
  - Composts and manures
- Reasonable crop rotations
  - Deep rooted, rotate to other crop families, crops that return high amounts of organic matter
- Reasonable tillage
  - Minimize if possible

Broccoli : a good rotation for lettuce production

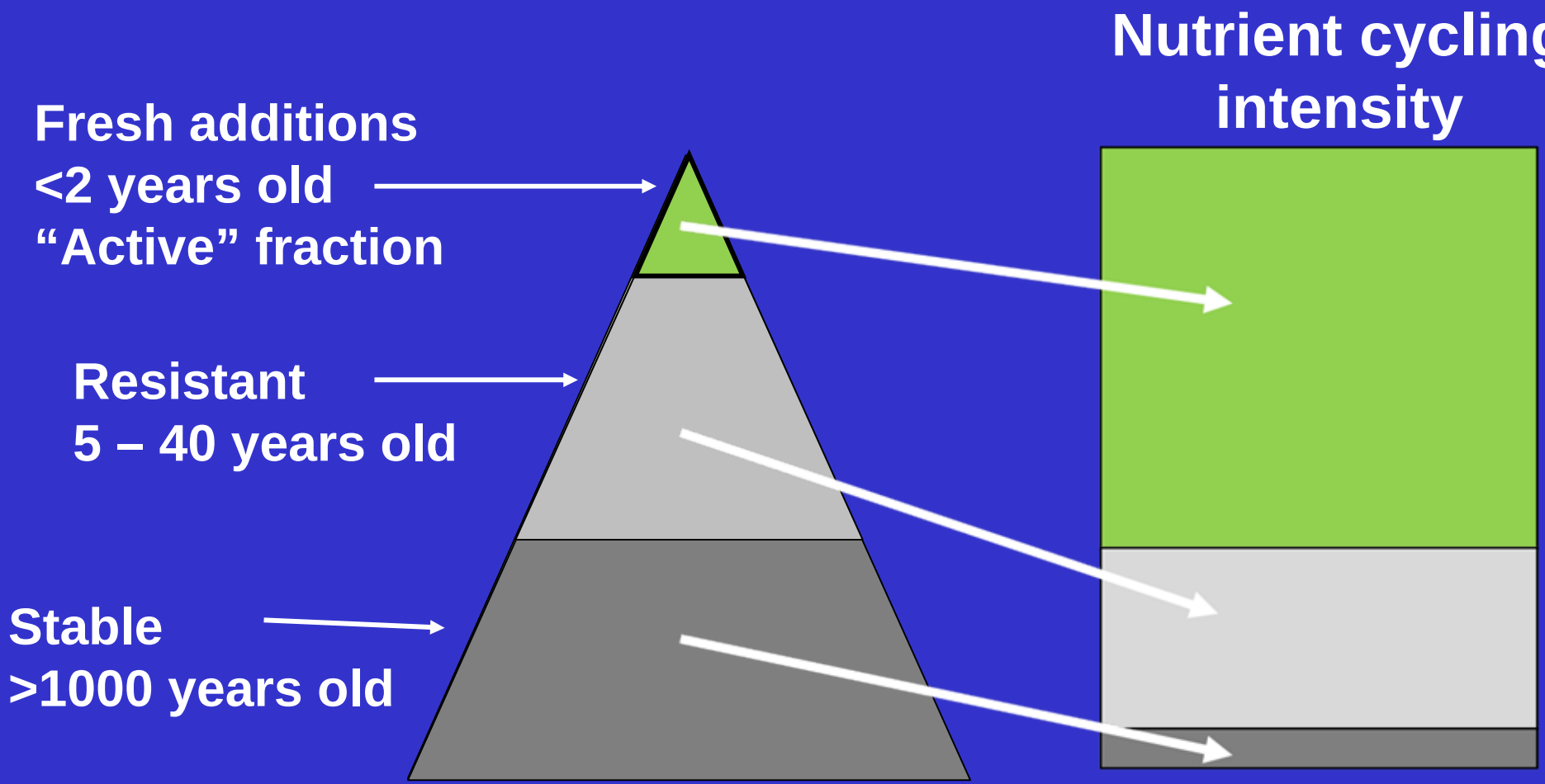
Beneficial Impacts of Organic Matter

- Microbial activity
- Nutrient additions, retention, chelation & cycling
- Tilth
- Aeration & infiltration
- Water holding capacity
- Disease & pest suppression
- Root penetration & crop growth

Organic Matter Content of Soils

- California soils range from <1.0 to 3.0% organic matter
- Generally 2-5% of organic matter decomposes each year
- Additions are needed to counter balance decomposition

Contribution of Soil Organic Matter Fractions To available soil nitrogen



From Horwath, 2005

Organic Matter

- Soils need additions of organic matter – this is especially so for intensively managed crops such as vegetables
- Organic matter contains nutrients needed to sustain microbial biomass and to provide nutrients to crops


Crop Residues


Cover crops

Tangible Benefits of Organic Matter

- Through the activity of microbes and the raw materials from the organic matter, improvements in soil health can occur: tilth (crumb structure), water infiltration, internal drainage, aeration and nutrient supply
- All of these factors are critical to a soil that is healthy, but that is easy to work and grow productive crops

Poor tilth - crusting

Good tilth – crumb structure

Comparison of Organic vs Conventional Soils

Soil Type	Management	Organic Matter Percent	Total Soil Nitrogen Percent
Clay Loam	Organic	2.24	0.17
Clay Loam	Conventional	1.78	0.14
Loam	Organic	1.74	0.14
Loam	Conventional	1.37	0.11
Sandy Loam	Organic	1.31	0.12
Sandy Loam	Conventional	0.66	0.06

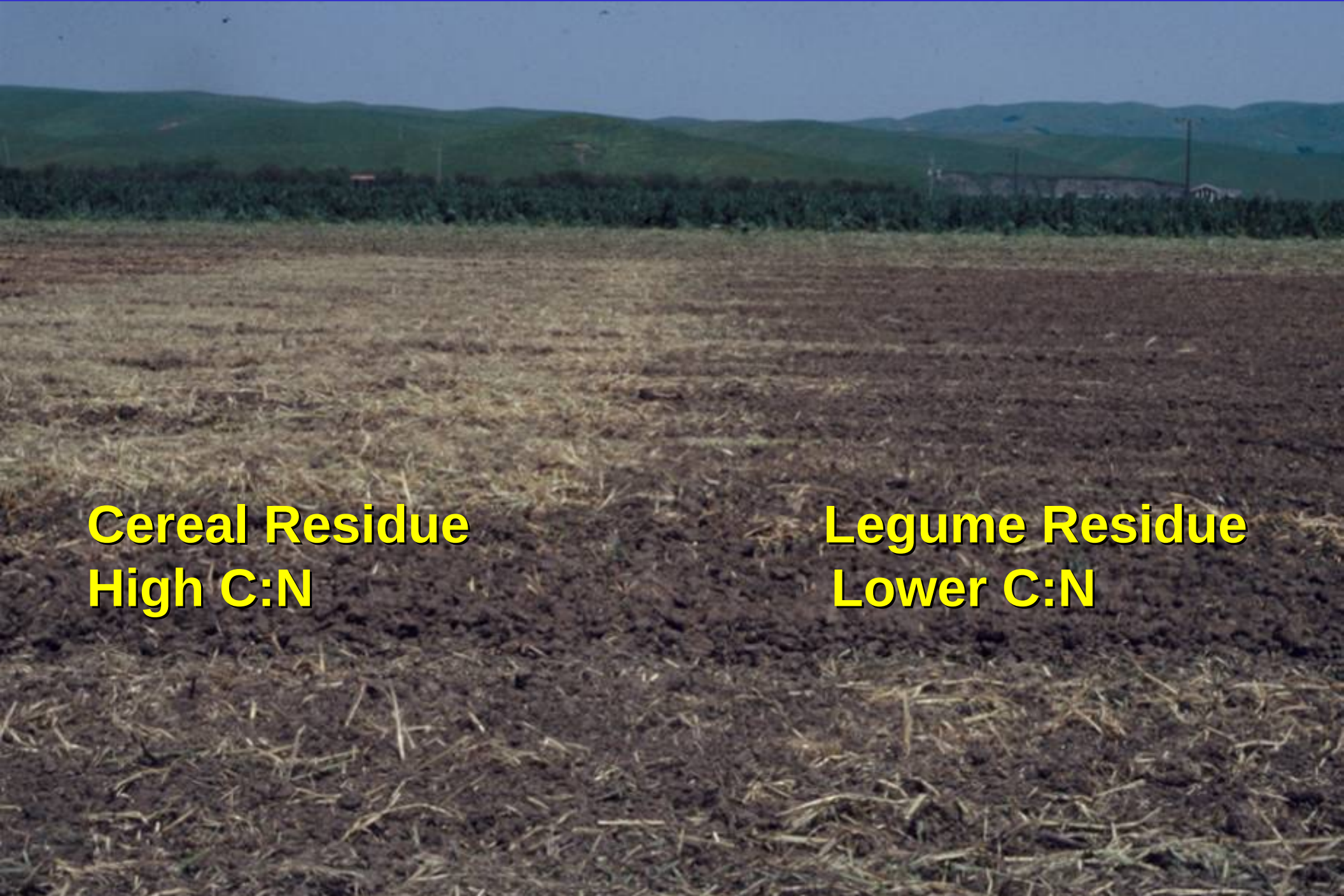
Smith, 2003

Types of Organic Matter

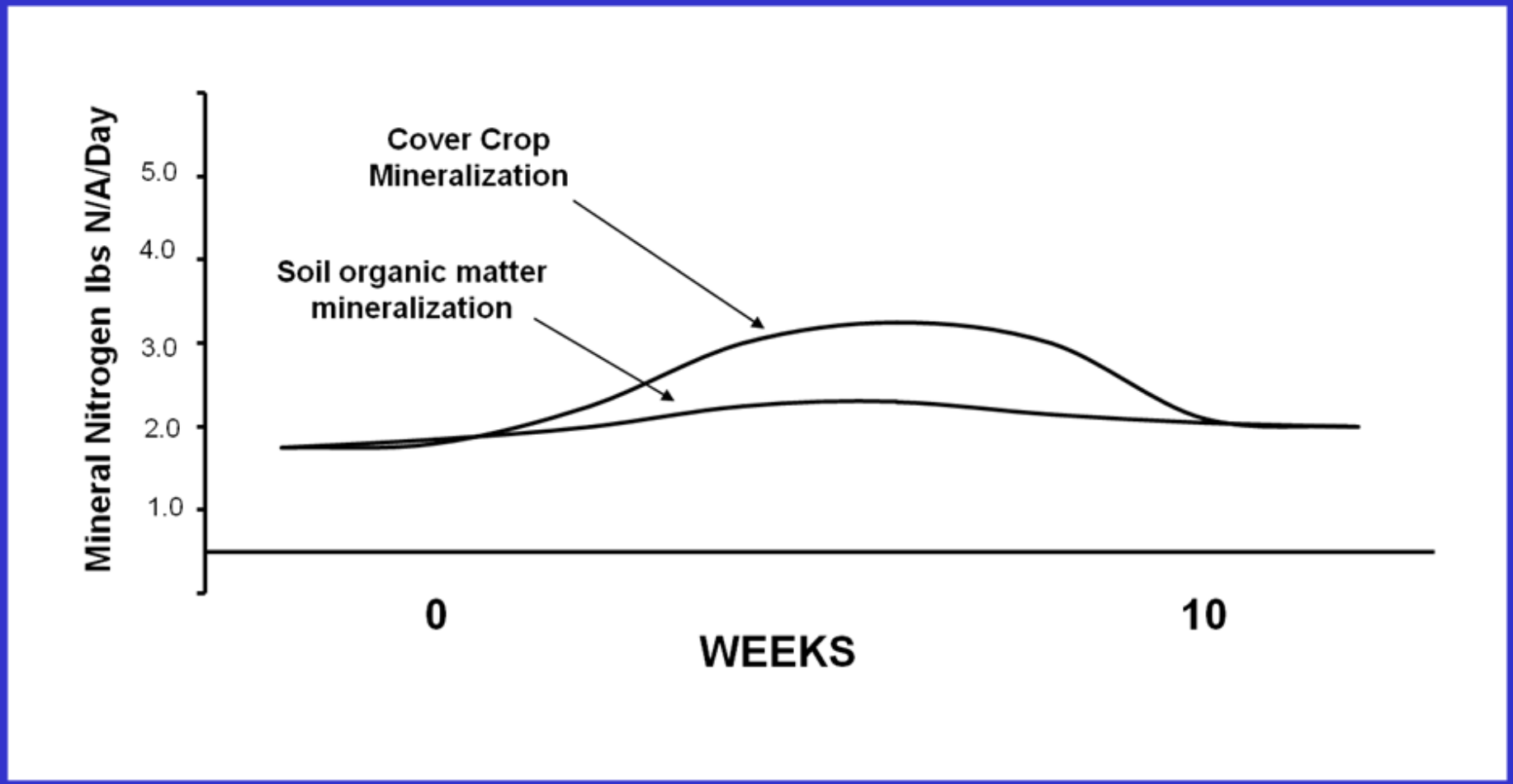
- Incorporation of cover crops that are rich in lignin
- Lignin provides the building blocks for humification
- Non-juvenile cereals (and other monocots) provide long-lasting benefits to the soil
- Composts are stabilized forms of organic matter and can also build up levels of organic matter

Succulent Lettuce Residues

Higher lignin cereal cover crop

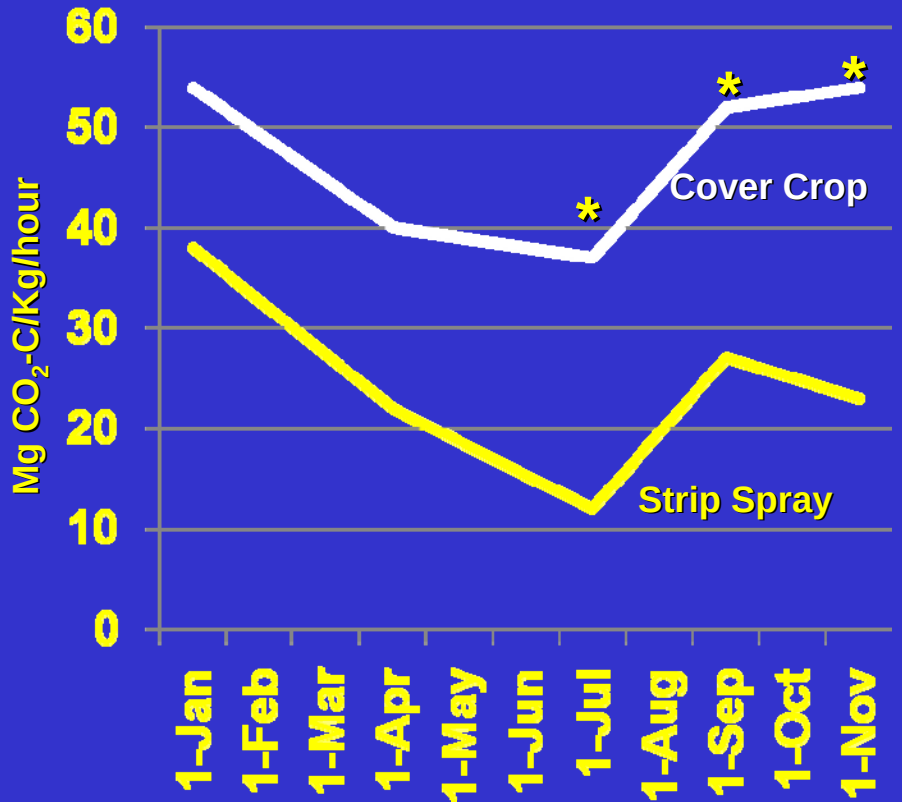

Cereal Residue
High C:N
Legume Residue
Lower C:N

Nitrogen Mineralization from Incorporation of Cover Crop Residue: Burst of activity that lasts for 6-10 weeds then returns background levels



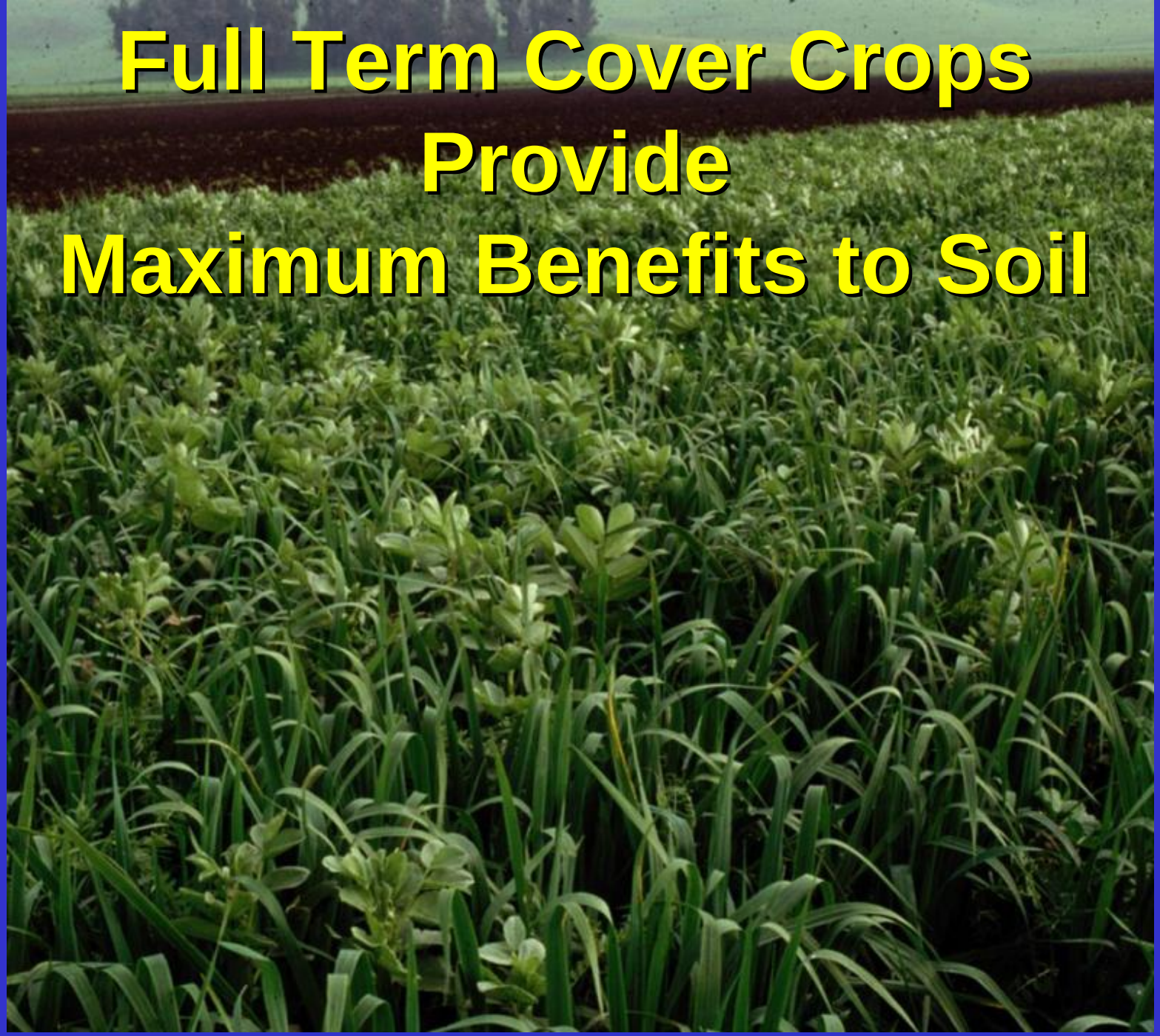

Strip Sprayed
Vine Rows
Cover Cropped
Row Middles

Cover Crop Impact the Vine Row Soil Microbiology



What are economical ways to increase soil organic matter?

- Include the use of composts in your production budget – take away the debate about whether to use it
- Include cover crops in crop planning schedules – as often as reasonably possible (e.g. every 2-3 years would be great)


Full Term Cover Crops
Provide
Maximum Benefits to Soil

Alternative Strategies

- Short-term cover crops
  - 30-40 days
- Low residue cover crops
- No-till strategies where appropriate

Fast growing Buckwheat

Low-residue cover crop

Conservation Tillage

May (or may not) have a fit for certain crops (e.g. pumpkins)

Cover Crop residue on soil surface

Bare

Planting into Residue

Three Resources:

1. Soil Fertility Management for Organic Crops: Google “cemonterey” and go to Publications; ANR catalog; free publications
2. In YouTube: type in “Cover crops Salinas” to see the low residue cover crop video
3. Cover Cropping for Vegetable Production: A Grower's Handbook – To be published in early summer