

# Soil Health Summit

## Wednesday, November 15<sup>th</sup>, 2017



**In collaboration with East Stanislaus RCD and USDA-NRCS:**

**Featuring technical trainings, research updates, carbon farm workshop, and networking with soil health professionals.**

# **Cover Crop: Challenges and Opportunities in California**

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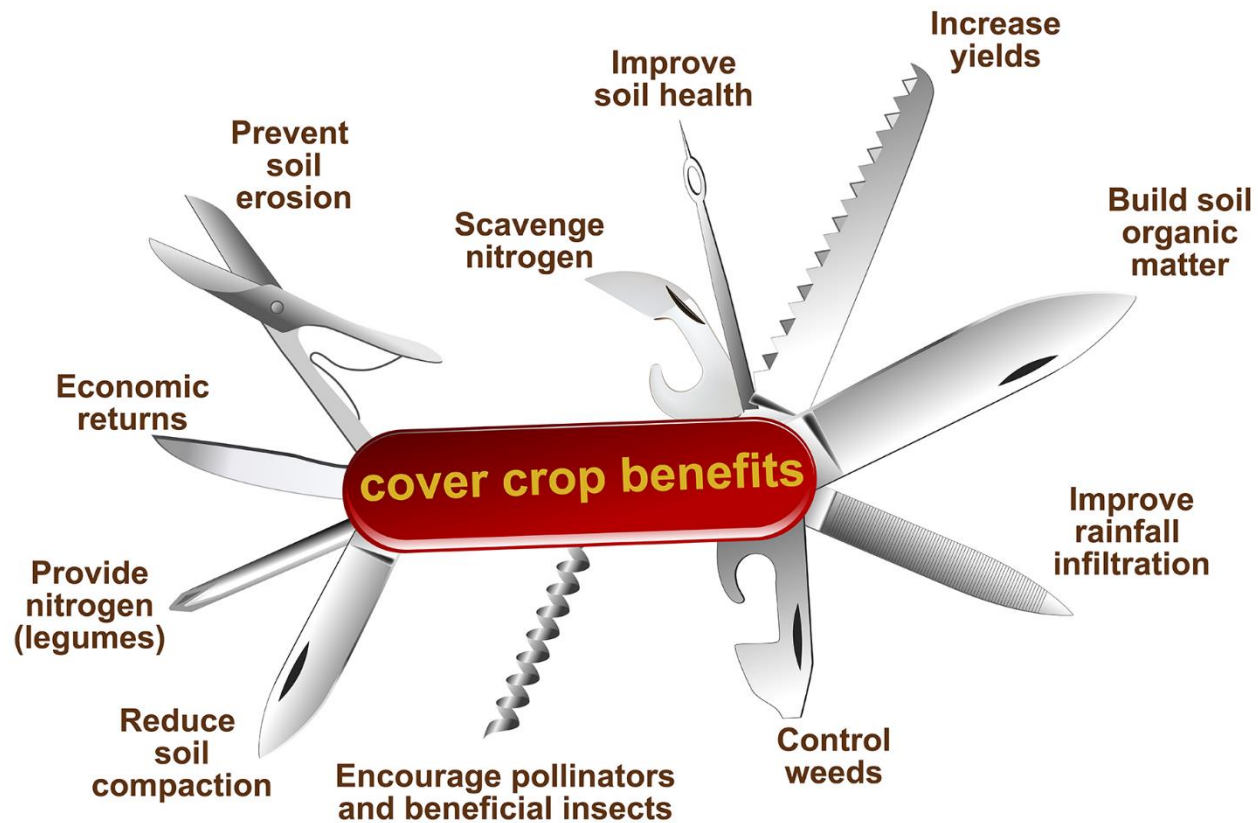


Illustration by Carlyn Iverson.

# Winter Runoff, Russell Ranch, UC Davis

Fallow



Cover Crop





# Farming Systems, UC Davis



**Agro-chemical based** -representative of typical California Central Valley system

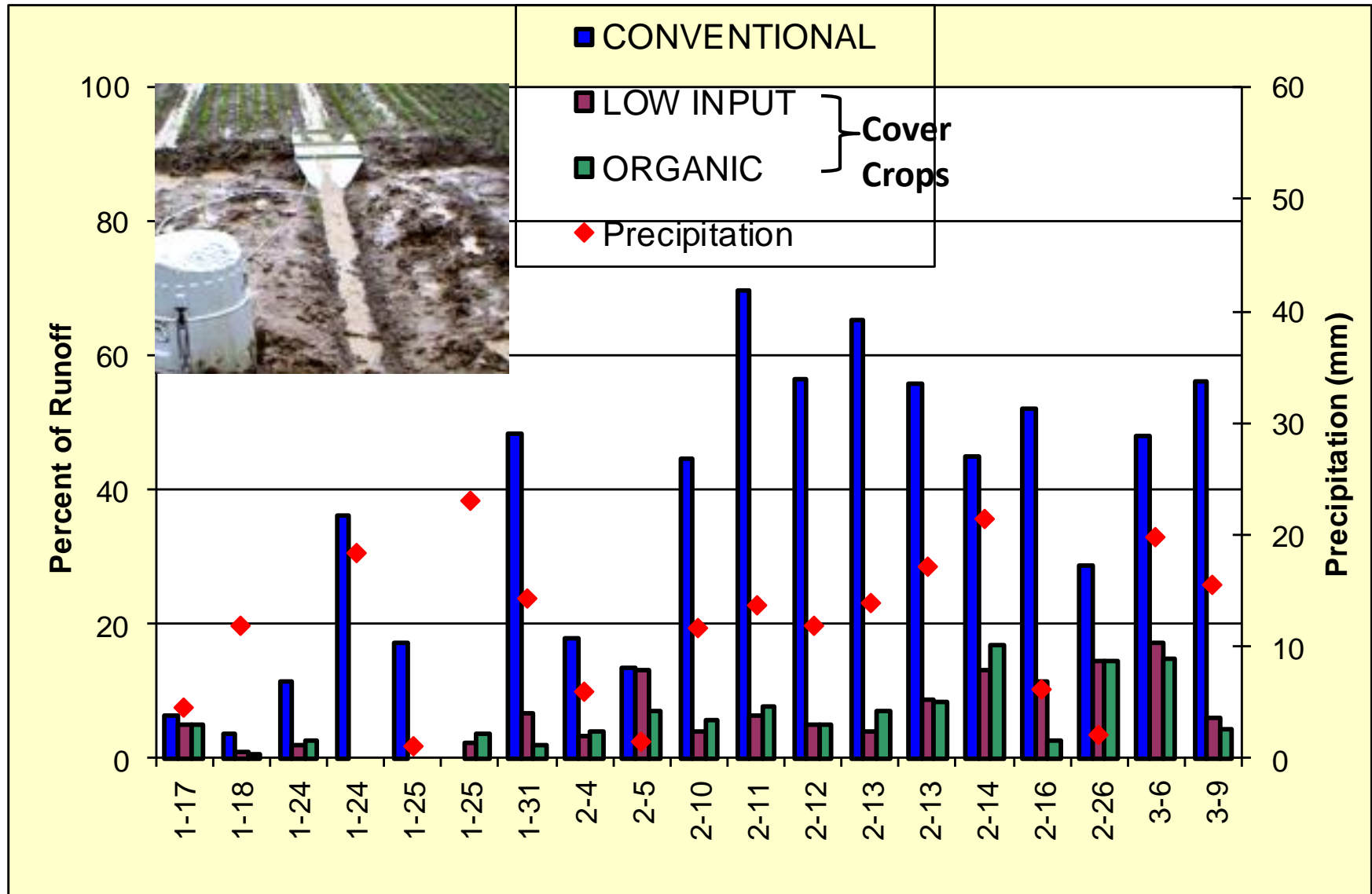


**Intermediate system** – Fertility from WLCC and some supplemental inorganic fertilizers; occasional pesticides and herbicides



**Managed according to USDA guidelines**  
– WLCC and organic fertility from composted chicken manure

# Runoff as Percentage of Rainfall, UC Davis



# Grower-Collaborator Field Site

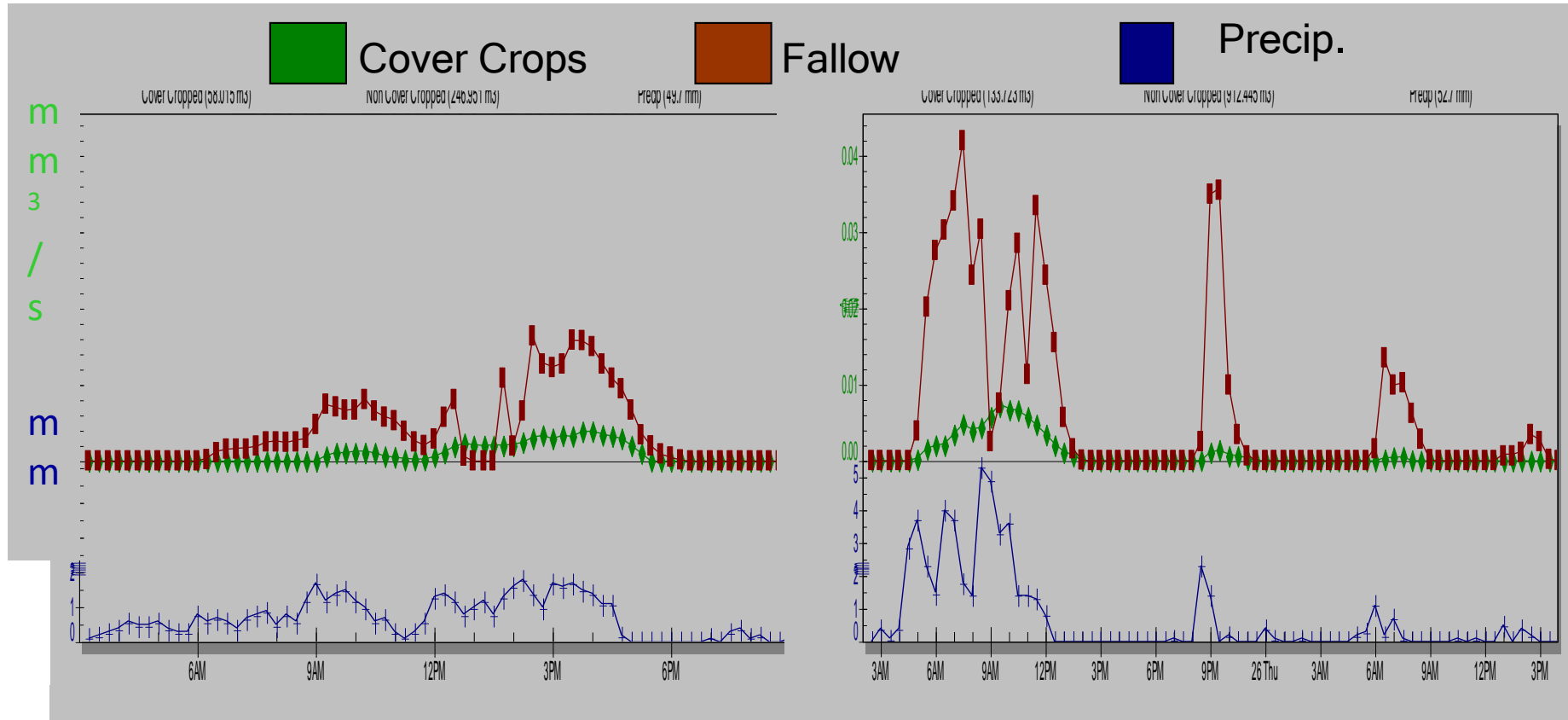


**Winter Fallow (NCC)**



**Winter Cover Crop (CC)**

# Discharge Hydrograph Comparing in Grower's Fields



Storm event 1

Storm event 2

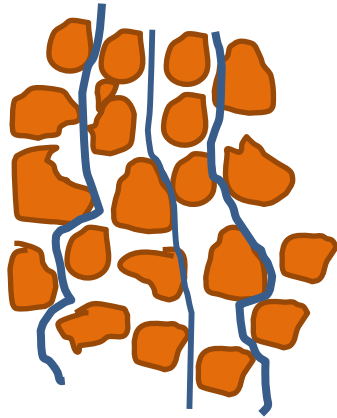


# Total Winter Discharge Comparisons in Grower's Fields

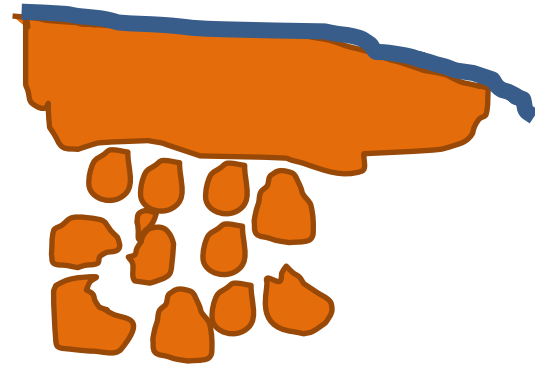
	Fallow (NCC)	Cover Crops
Precipitation Discharged as Runoff	16.3%	0.9%
Average Peak Runoff Velocity	0.52 m/s	0.24 m/s

Kabir & Horwath

# Soil Surface and Water Flow Pattern



**Good aggregated soil**



**Soil Seals and crusts**

**January 8, 2017**



**Adjacent Field - Same Day**



Photo: T. Rolfes

# After a Storm Event in Solano Walnut Orchard



**Poor Soil Structure & Poor Soil Health**



**Healthy Soil with Good Structure**



# Almond Orchard: Fallow and Cover Crop in Yolo County



Photo: Kabir, Feb. 21, 2017

# Orange Grove



Kabir: Feb. 16, 2017



Photo: Chuck Ingels



# Cover Crop Enhance SOM

## Soil Organic Matter (SOM)

- Cover Crops provide a continual live root to harvest additional sunlight



Photo: Jay Fuhner, NRCS

### Upward Trend



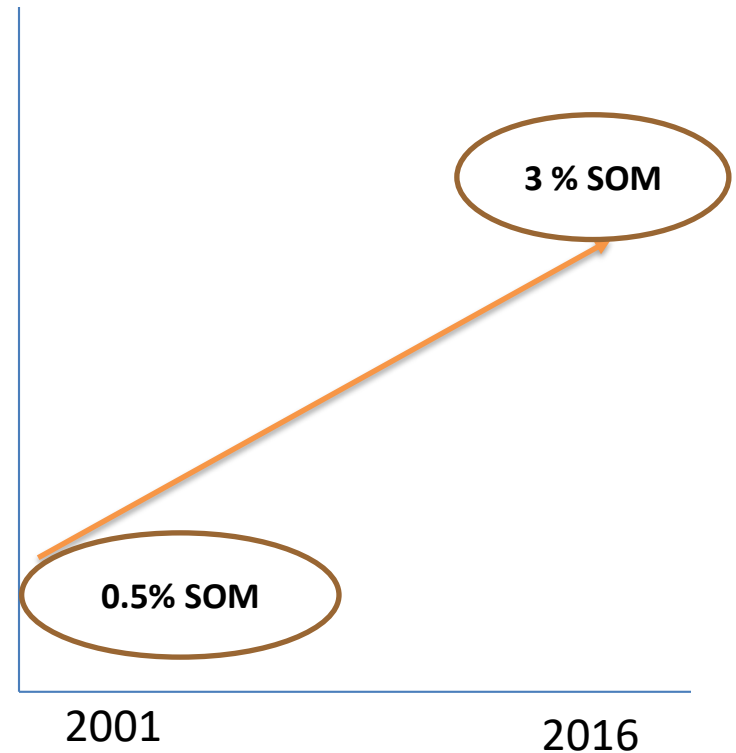
- 1993..... 1.7 to 2.0%
- Present ..... 3.7 to 4.3%



NCAT The National Center for Appropriate Technology • [www.ncat.org](http://www.ncat.org) • 1-800-275-6228 (1-800-ASK-NCAT)

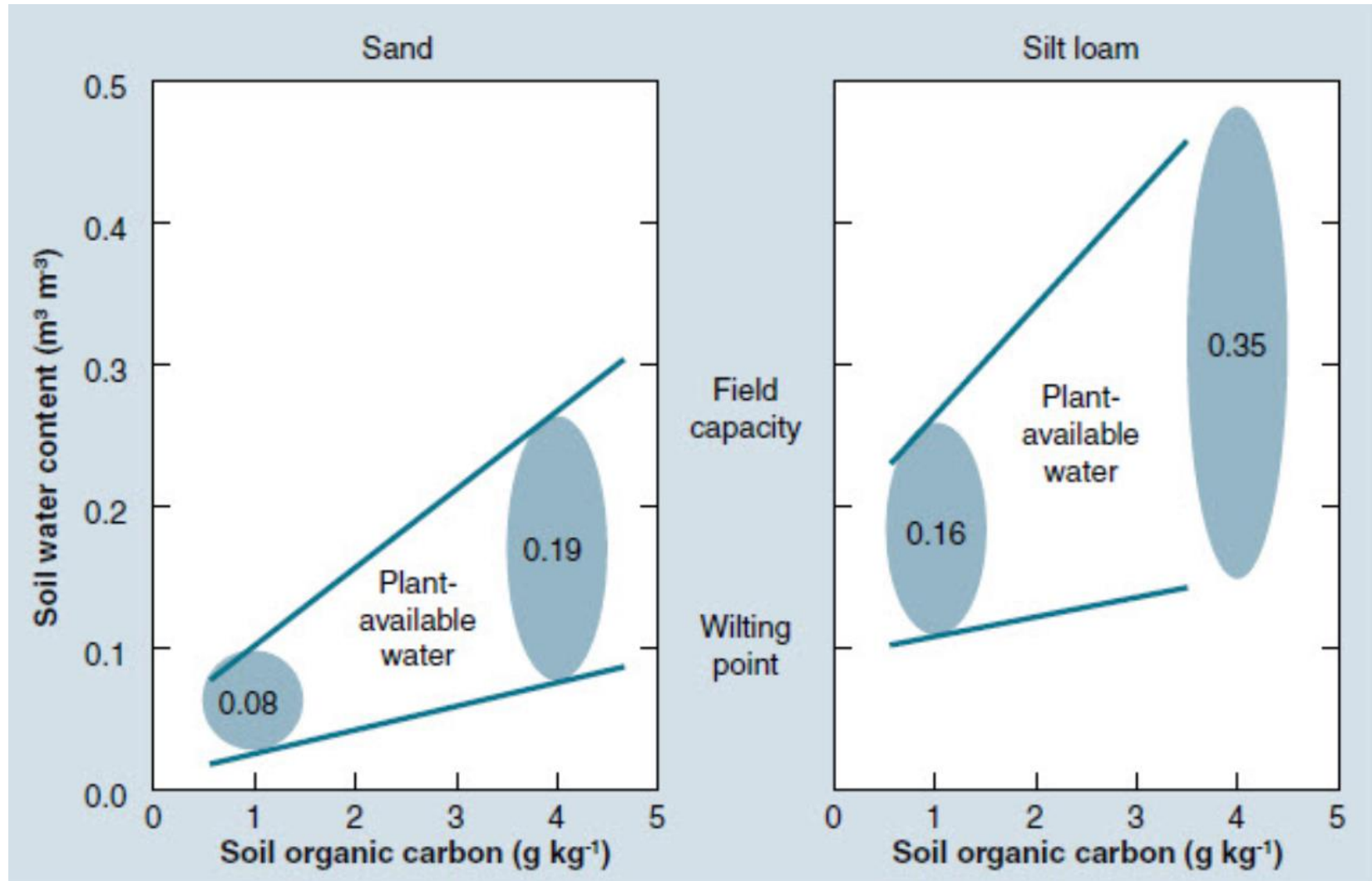
15

Brown Ranch, ND



Sano Farm, Fresno, CA

# SOM Boosts Water Holding Capacity



(Hudson, 1994, as redrawn in Franzluebbers, 2010)



# Spring Weed Pressure



*Photo: Jay Fuhrer, NRCS*

- Cover crop

- No cover crop



NCAT

The National Center for Appropriate Technology • [www.ncat.org](http://www.ncat.org) • 1-800-275-6228 (1-800-ASK-NCAT)

## 2007 Herbicide Expenses

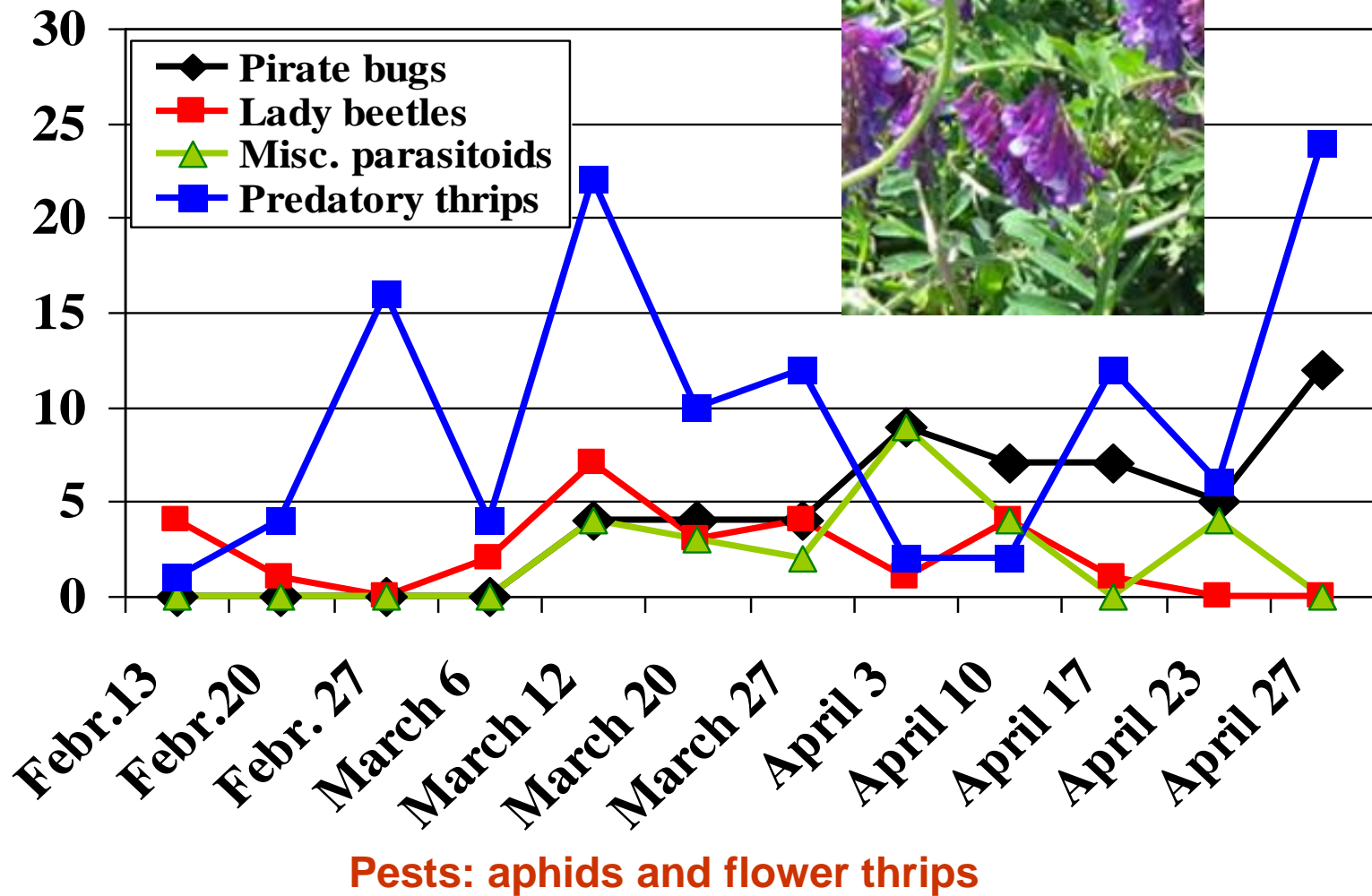
Field	Treatment	Herbicide Applications After Pea Harvest Cost per application = \$12.00/ac		
North	Cover Crop No Manure	July 1×	Sept None	\$12.00 🖱️
Middle	No Cover Crop Manure	July 1×	Sept 1×	\$24.00
South	No Cover Crop No Manure	July 1×	Sept 1×	\$24.00



# Cover Crop Attract Beneficial Insects



# Vetch Cover Crops and Beneficial Insects





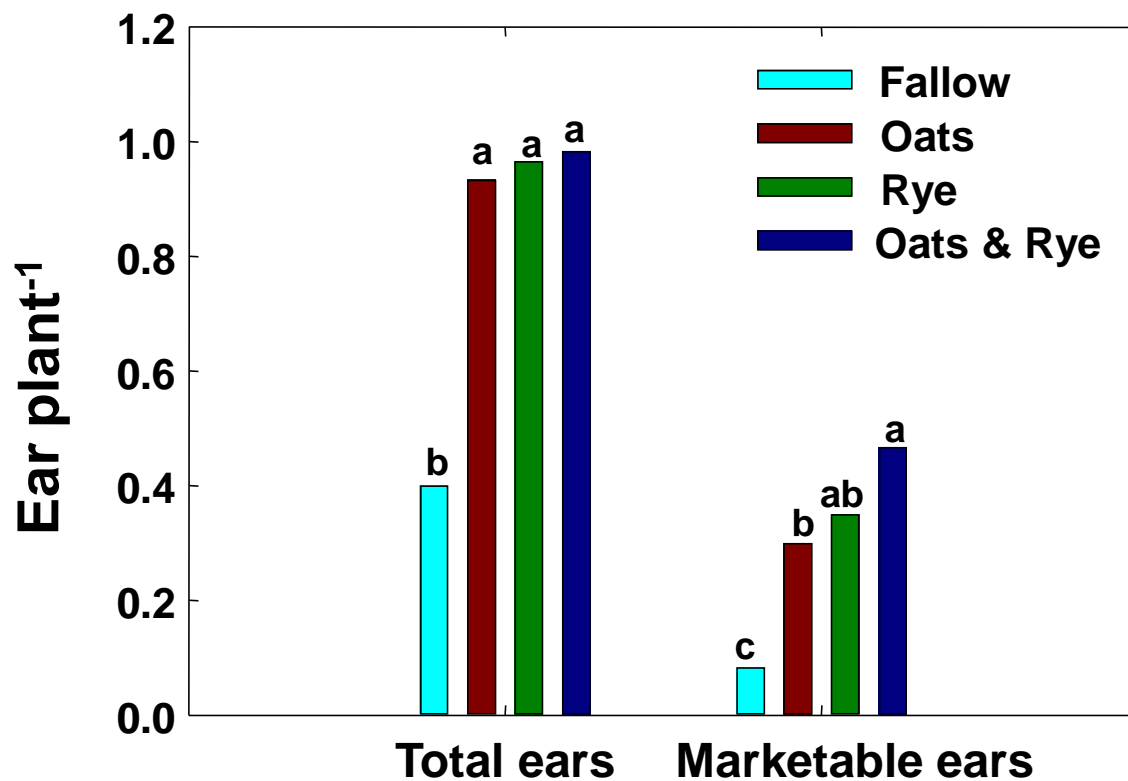
# Sweet Corn Tassels in Cover Crop and Fallow plots



**Fallow plot**

**Cover Crop plot**

# Ear Production of Sweet Corn in Different Cover Crops



# **Aboveground Benefits**

- **Protect soil from erosion**
- **Mitigates chemicals runoff from the field**
- **Increases organic matter and water holding capacity**
- **Reduces nutrient inputs and herbicide use**
- **Promotes beneficial insects thus prevent pest outbreak**
- **Increase crop yield**

# Belowground Process

— Same Field —



*Photo: Jay Fuhrer, NRCS*

June 16, 2009

- Corn planted into last year's cover crop residue



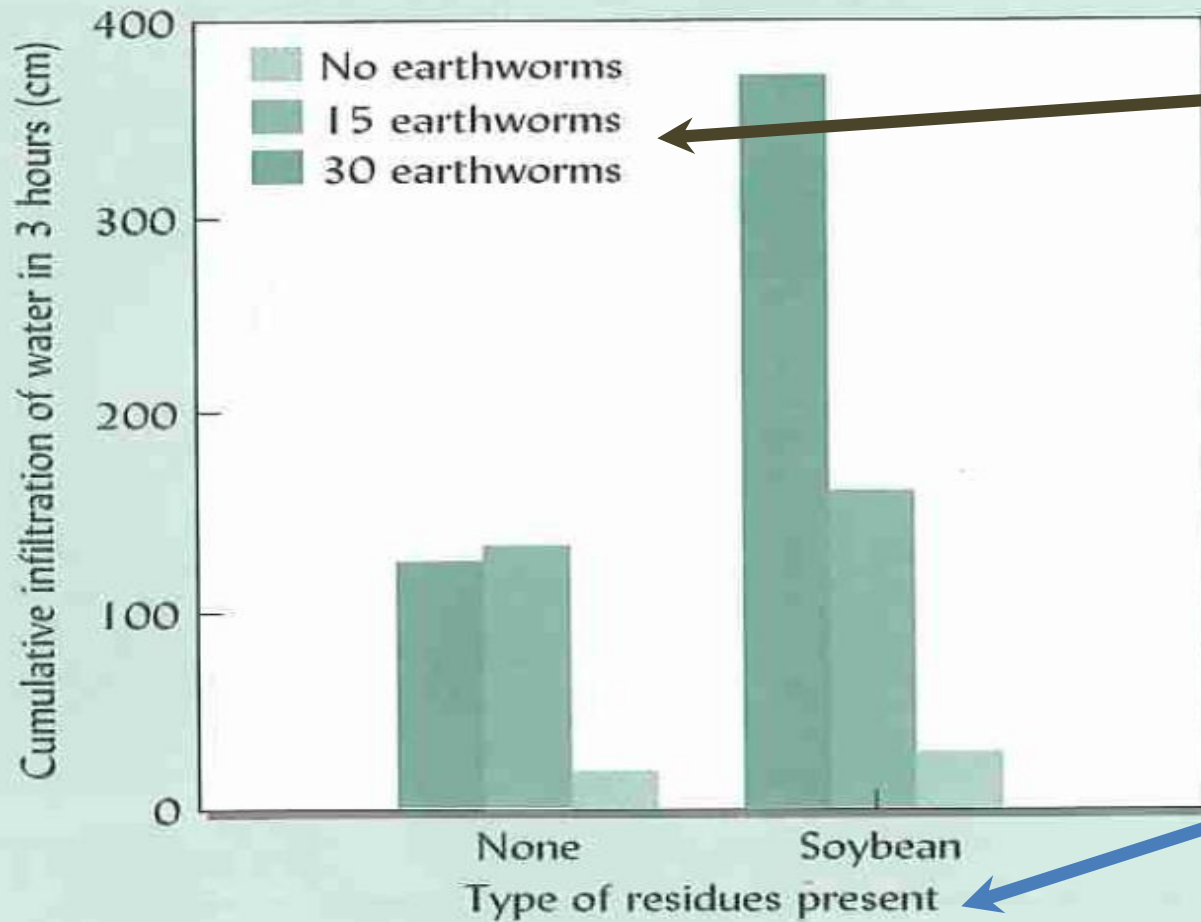
*Photo: Jay Fuhrer, NRCS*

July 1, 2009

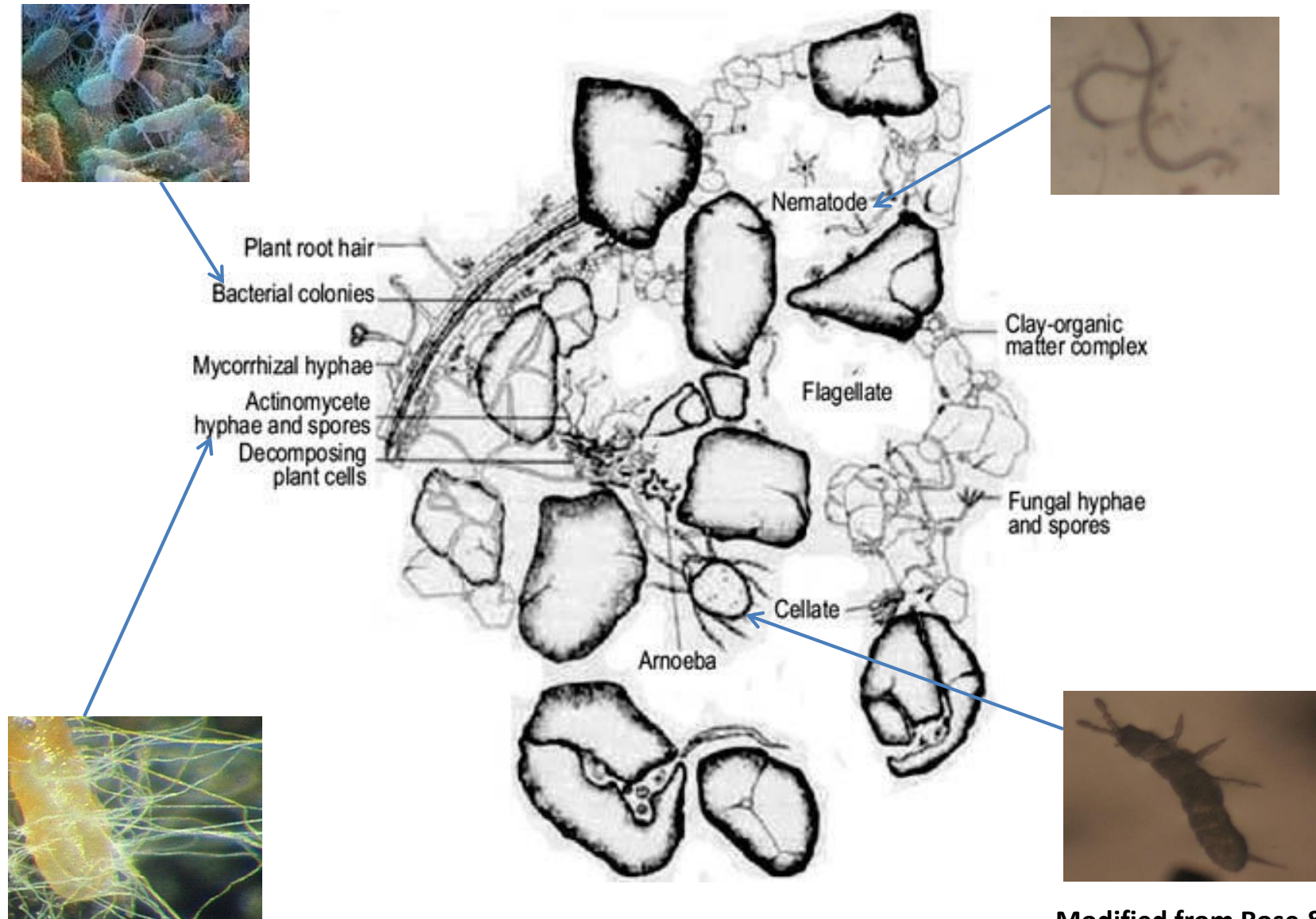
- Rapid residue decomposition



# Effects of Crop Residues on Earthworms Activity



# The Hidden World Under Our Feet



Modified from Rose & Elliott

# What Do They Weigh?

Bacteria	2,000 - 2,500 lbs/ac
Fungi	1,000 - 15,000 lbs/ac
Protozoa	20 - 300 lbs/ac
Nematodes	10 - 300 lbs/ac

## Sources:

*The Nature and Properties of Soils, Fourteenth Edition.*

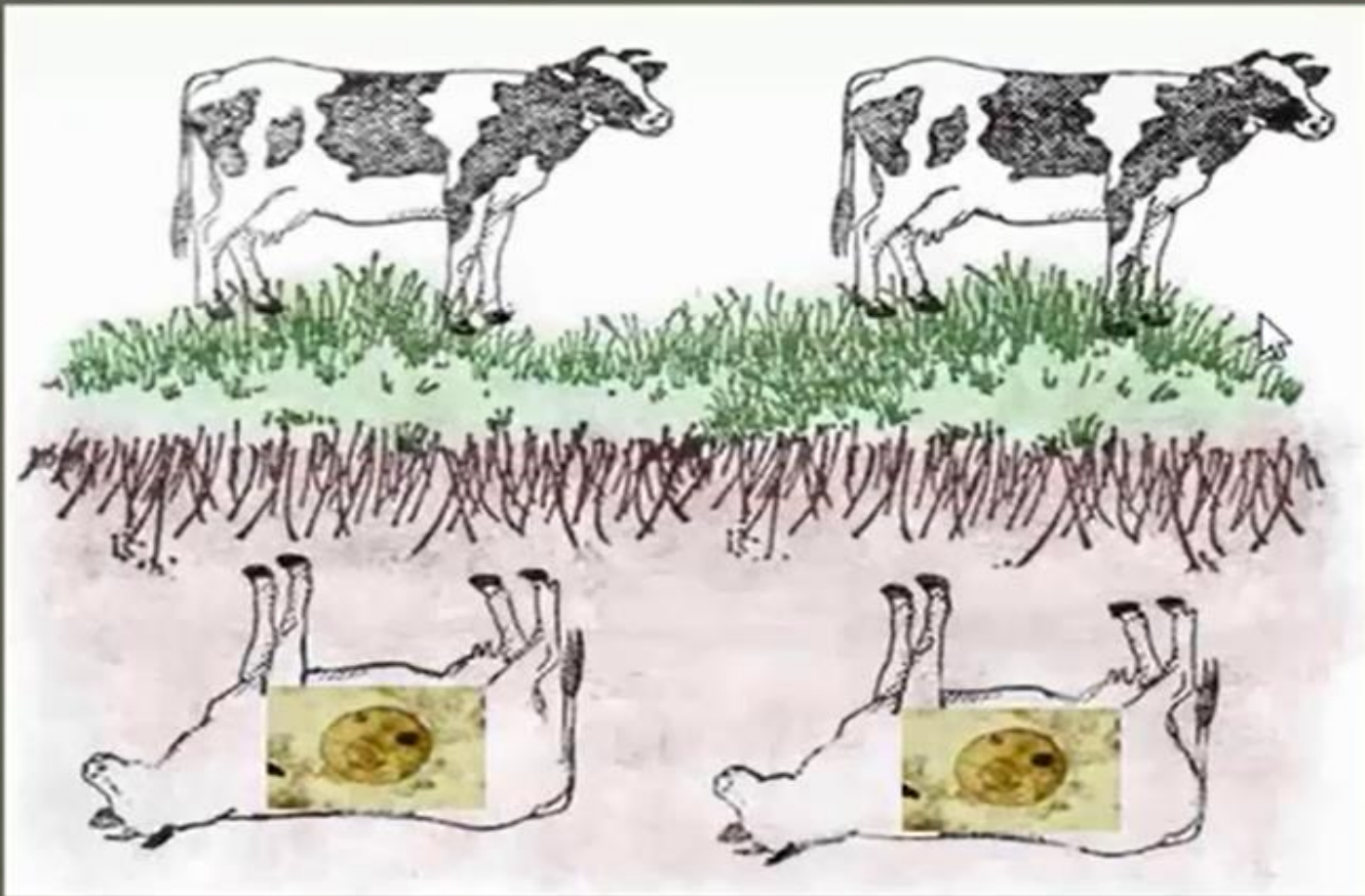
*Dr. Nyle C. Brady and Dr. Ray R. Weil*

*Soil Biology Primer. Dr. Elaine R. Ingham*



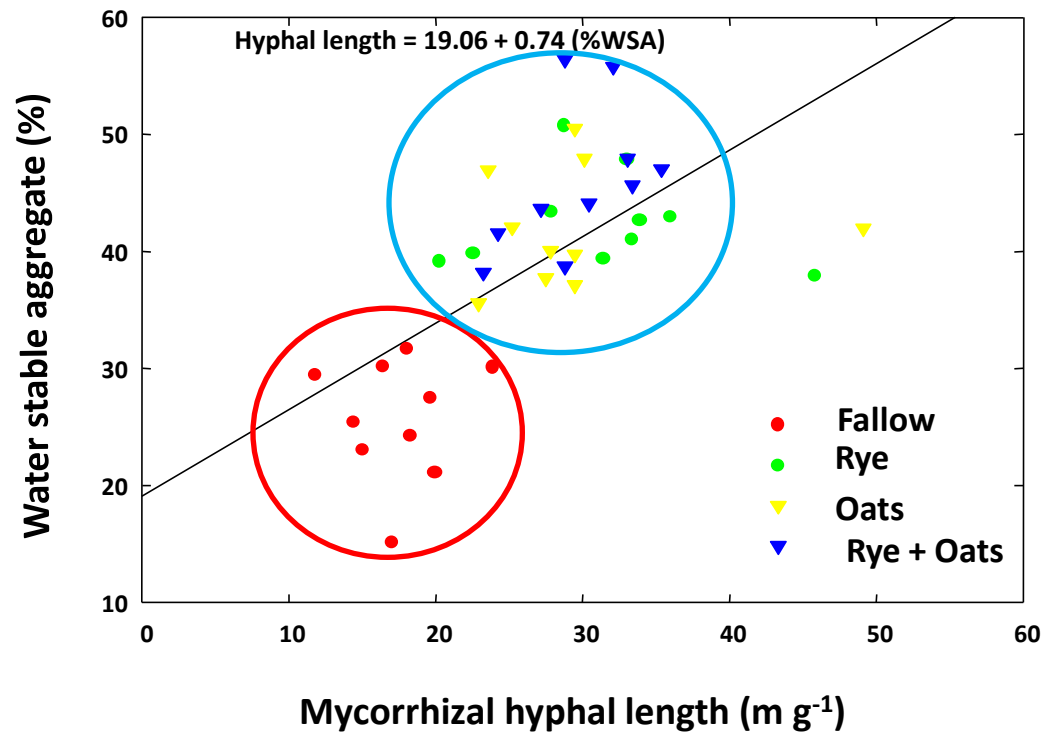
# Bacteria & fungi in a acre of land equivalent to

Feed the Underground Herd!





# Soil Aggregate Stability



Kabir and Koide, 2002

# Belowground benefits

- Increase microbial population thus increase mineralization
- Improve soil biology
- Increase soil aggregate stability

# **Management Challenges of Cover Crops Planting**

- **Delay in planting of cash crop**
- **Choice of cover crops for more benefits**
- **Economic loss**
- **Nutrient tie-up**
- **Frost Damage**
- **Pest and Disease may carry over to the main crop**
- **May interfere harvesting of crops**

# Majority of California Cropland





# Cover Cropping in the Furrows





E. Brennan, USDA-ARS



# Winter Killed Cover Crops



Foxtail millet



Buckwheat



Cowpea

# Choice of Cover Crops based on Season



Fall

Winter



Spring



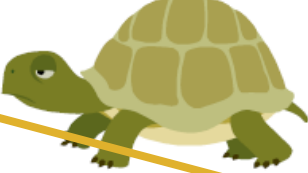
# May interfere Almond Harvesting




# C:N ratio in Cover Crops

## (Nutrients Availability & Decomposition Rate)

Material	C:N Ratio
rye straw	82:1
wheat straw	80:1
oat straw	70:1
corn stover	57:1
rye cover crop (anthesis)	37:1
pea straw	29:1
rye cover crop (vegetative)	26:1
mature alfalfa hay	25:1
<b>Ideal Microbial Diet</b>	<b>24:1</b>
rotted barnyard manure	20:1
legume hay	17:1
beef manure	17:1
young alfalfa hay	13:1
hairy vetch cover crop	11:1
soil microbes (average)	8:1






slower



Relative Decomposition Rate

faster



# Cover crops may Enhance Frost Damage to Orchard or Vineyard



**Almond frost damage, UC IPM**



**Tall & Dense Cover Crop**



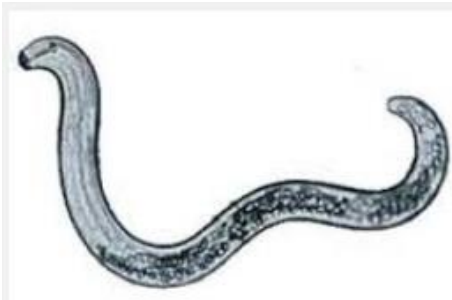
**Low profile Cover Crop**

# Combat Nematodes

- Sudan grass
- Mustard
- Cahaba white vetch
- Cowpeas



Root knot nematode



**5,000 lesion Nematodes  
in 2012 to 126 in 2016  
by using three mustards  
& a daikon radish cover  
crop**



# Rust on Cover Crop may Carry Over to Corn





# Cover Crops may Serve as Sources of Inoculum for Diseases in Cash Crops



**Vetch**



**Sclerotinia on vetch**



# Conclusions

- Identify what you want the cover crop to do?
- Examine crop rotations to identify “windows” where cover crops can fit
- In orchard or vineyard use multispecies cover crops to receive maximum benefit

# Thank You



## Any questions?