Why use cover crops?

- **Cover crops are an important soil management tool for organic farmers**
- **Covers are grown primarily for soil or ecosystem improvement, not cash**
- **Covers can be critical and useful components of a farming system, but can have negative consequences if managed incorrectly or the wrong species is chosen.**

What's in a Name?

- **What are:**
  - **cover crops, green manures, catch crops?**
- **Frequently used interchangeably, but refer to different functions:**
  - **Cover crop = used to prevent soil erosion by 'cover'-ing soil with living plants**
  - **Green manure = turned under for soil improvement or nutrient supply ('manure')**
  - **Catch crop = used to "catch" nutrients left after harvest of a cash crop and prevent leaching**

Cover Cropping for Soil Management:

- *Improve soil physical properties*
- *Conserve soil moisture*
- *Protect water quality*
  - *Scavenge nutrients/prevent leaching*
  - *Prevent erosion*

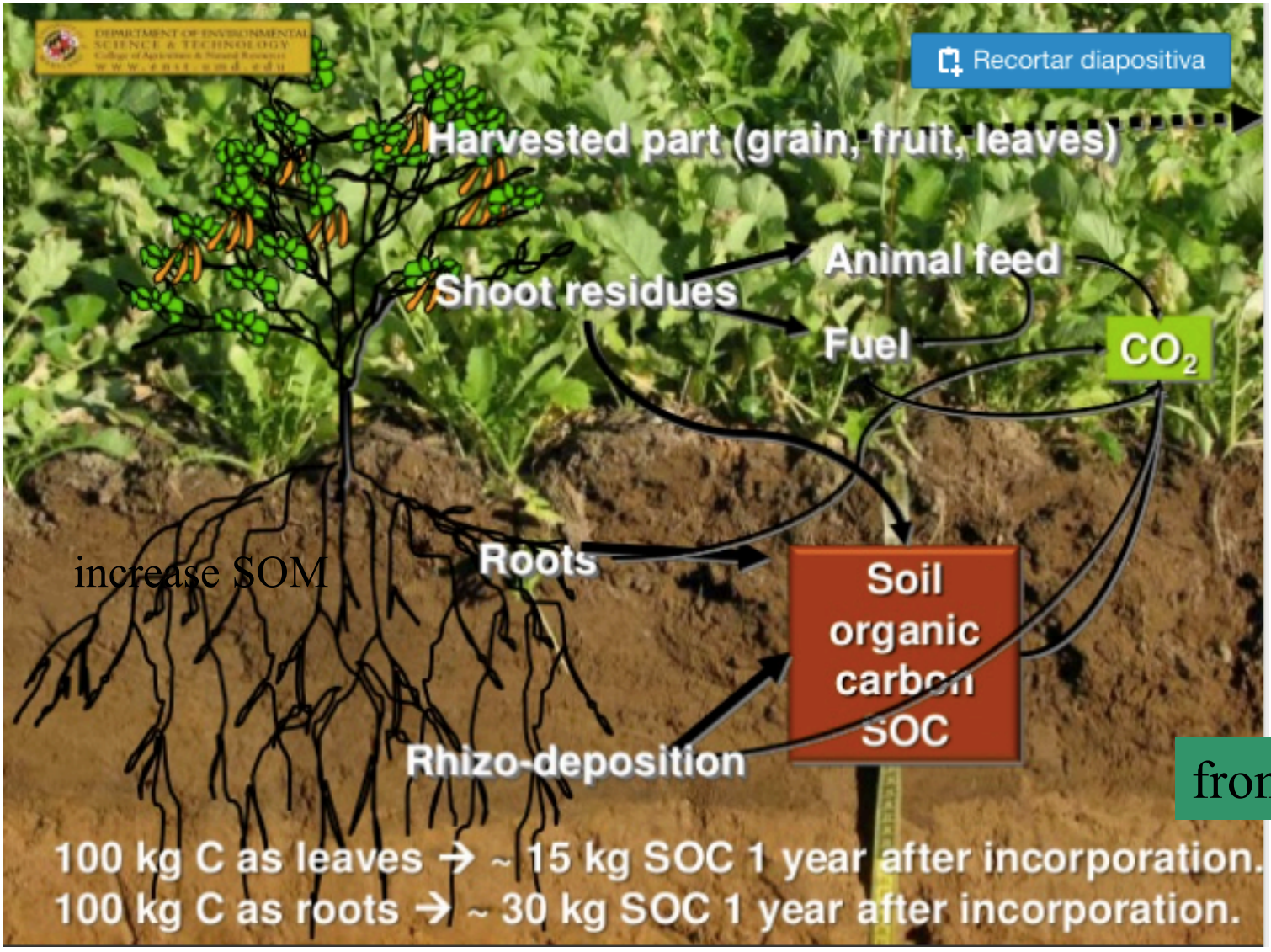
Goal: improve soil physical properties

- **increase root and microbial activity - production of roots, root hairs, and extracellular "glues" and fungal strands that enhance aggregate stability**
- **increase water infiltration due to increased porosity - both macro- and micro-pores**
- **mixtures of many species [including legumes (fix N, break down quickly) and non-legumes (deeper/more extensive roots, break down more slowly, etc)] to provide multiples benefits and longer acting aggregation support**
- **deep-rooted species can break through compacted layers in the soil and improve infiltration**
  - **e.g. Sorghum-sudangrass, sweetclover, annual ryegrass, tillage radish**

Cover crop roots build soil bio-physical quality

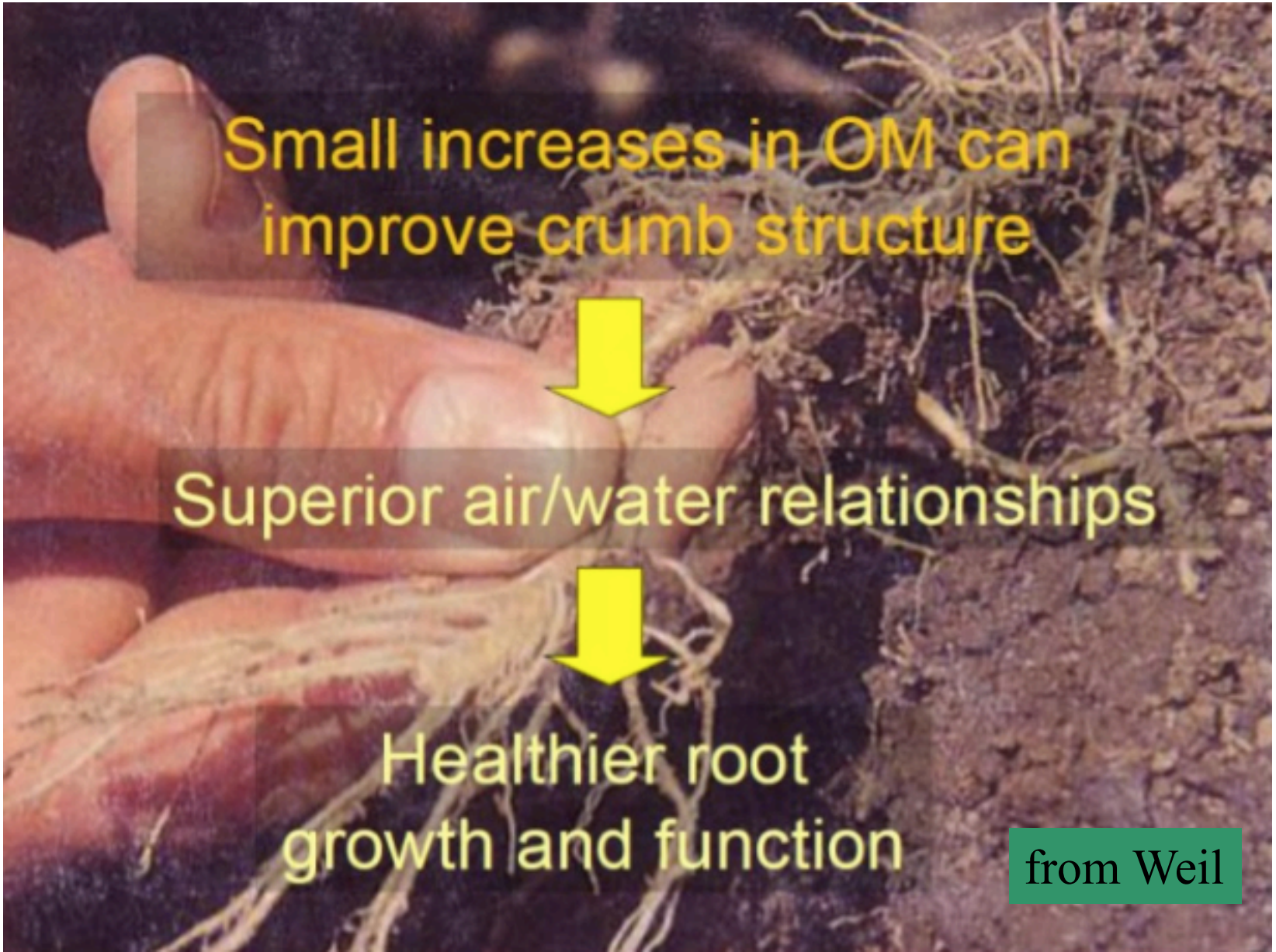
from Weil

plant residues (shoots/roots) sequester carbon – and roots are more efficient



from Weil

roots support aggregation



roots and root hairs support macro- and micro-aggregation

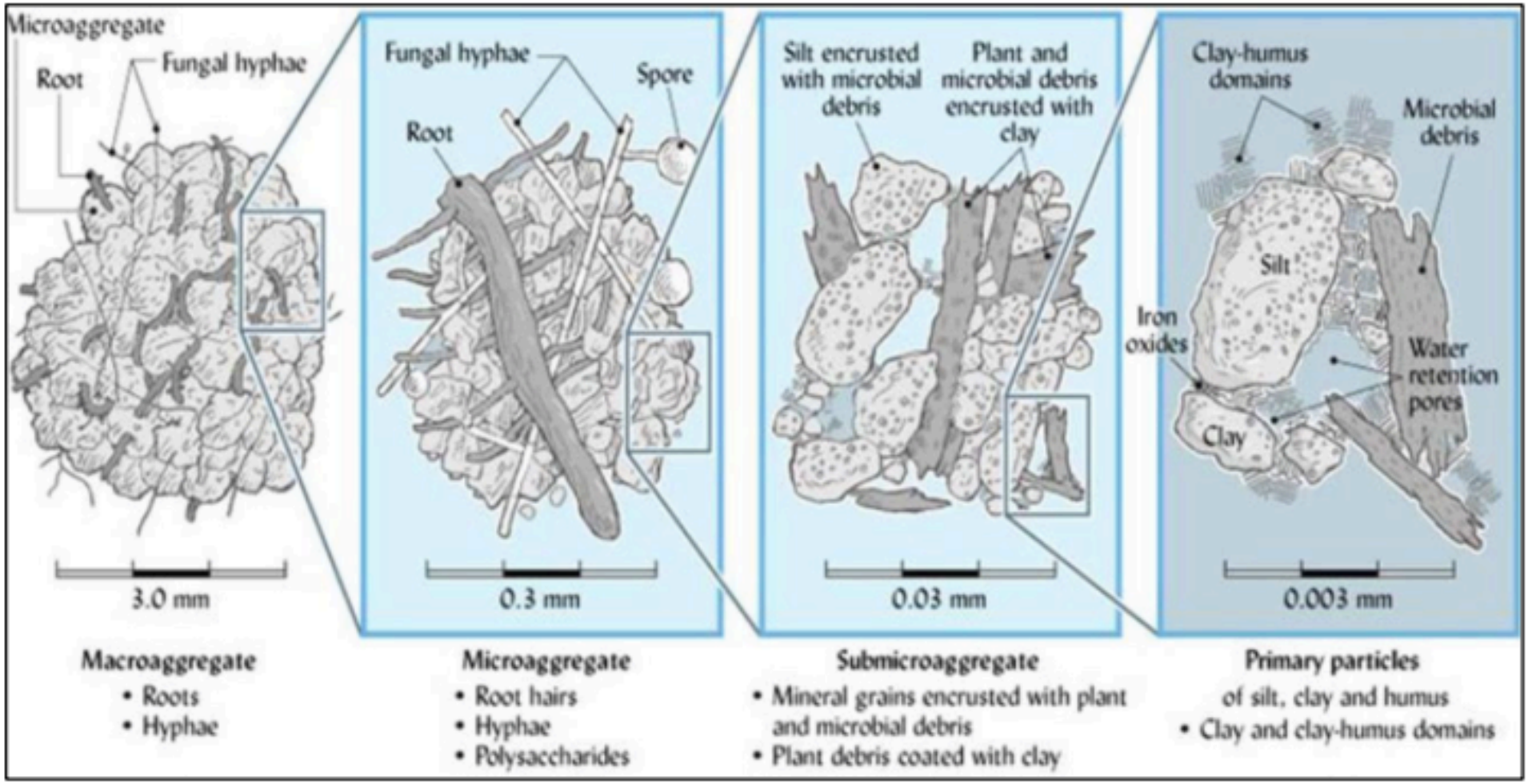


Figure 1.3. Soil aggregate size and composition. Adapted from Brady, N. C., and Weil, R. R. (2010). *Elements of the nature and properties of soils*. Upper Saddle River, NJ: Pearson Prentice Hall.


A little extra organic matter goes a long way to stabilize aggregates and keep soil surface open.
Increase aggregation
Reduce water erosion
LOW O.M.
HIGH O.M.

from Weil

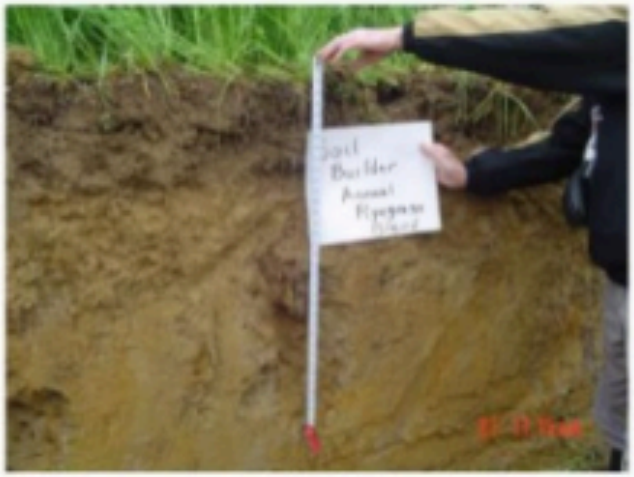
deep-rooted species can break through compacted layers in the soil and improve infiltration and crop growth

sorghum-sudan grass, sweetclover, annual ryegrass, tillage radish

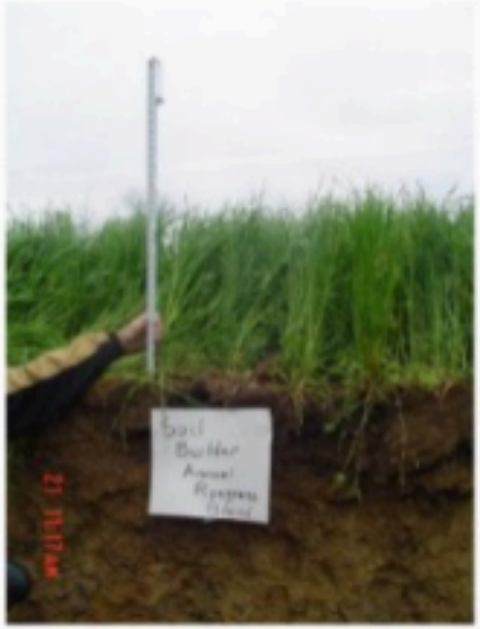
from Weil

Radishes are not the only good bio-driller!!

Annual Ryegrass



35" root depth



20-22" top growth

- much less top growth but deeper roots than cereal rye
- much less winter hardy than cereal rye
- can be difficult to kill with tillage
- can be a serious weed in small grains

from Gruver

Re-Imagining Roots

Jerry Glover, The Land Institute, Salina KS (Discover Magazine)

Jerry Glover, The Land Institute, Salina KS

Annual wheatgrass root growth (shown on the left side of each column) cannot compete with better-established, more robust roots of a perennial variety, which may be the future of farming.

The Land Institute

Discover Magazine

Goal: Mulch to Conserve Soil Moisture

from Gruver

Goal: Provide mulch to conserve soil moisture

- **For weed suppressive mulches look for a combination of high above ground biomass and moderate or high C:N ratio residues.**
- **Most legume residues with their high nitrogen content will decompose too rapidly to be effective.**

high residue organic no till video

https://www.youtube.com/watch?v=-lcwB9h-MCA

for more organic no till: Weed ‘Em and Reap Part 2
http://articles.extension.org/pages/18368

Soil Moisture and Cover Crops

- **Cover crops transpire water – they can help dry out soil profile in a wet spring**
  - **But …..**
- **Cover crops can delay early plantings because of need to incorporate. If it is too wet, it may be difficult or impossible to incorporate (and damaging to the soil)**
- **When water is limited (California, Oregon?) - need to carefully consider trade-offs of using cover crops**
  - **Timing critical**
  - **Use species with high water use efficiency**

Goal: Protect Water Quality
A: scavenge nutrients & prevent leaching

- To maximize nutrient scavenging the cover crop should have an extensive root system that develops quickly after planting.
- Non-legumes such as small grains, cereal rye, triticale, rapeseed, annual rye grass oilseed radish and mustards work well, but some legumes are also suitable.

cereal rye cover crop scavenges nitrate over the winter

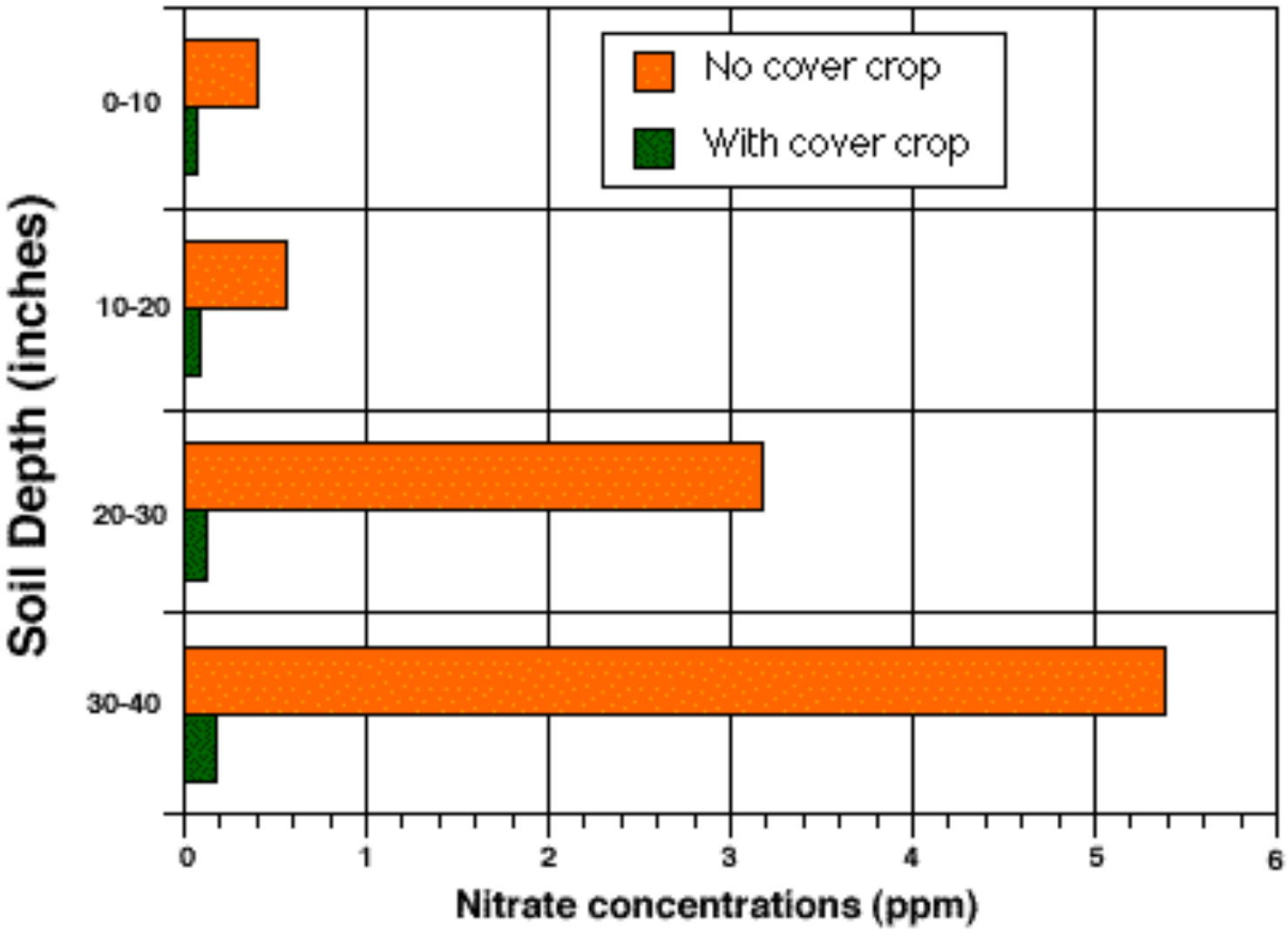
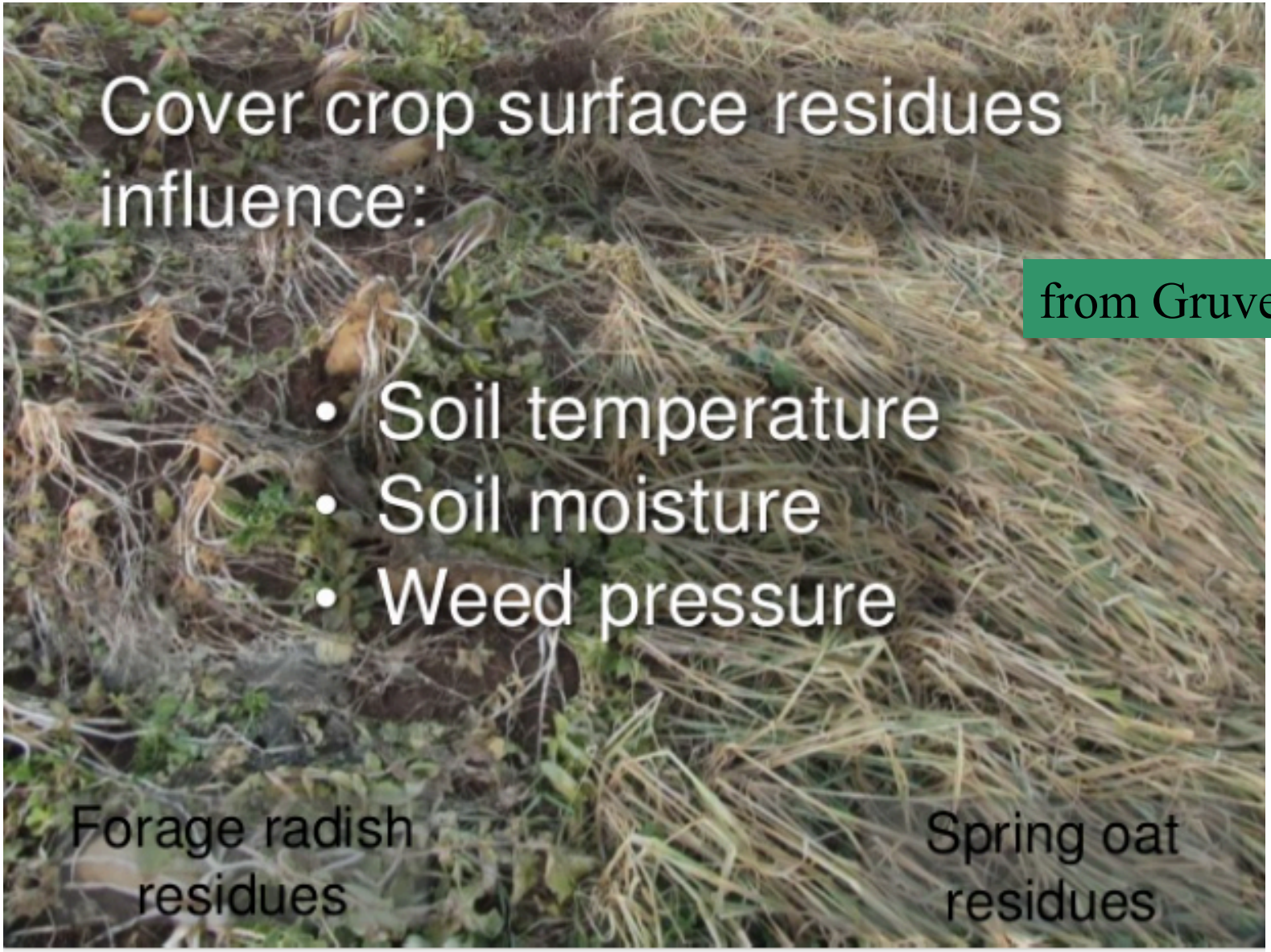


Figure 3. Effect of a cereal rye cover crop on soil nitrate concentrations (ppm) in broccoli plots fertilized the previous spring with 250 pounds N/acre. Samples were taken April 15, 1992. (Data from Hemphill and Hart, 1993.)

Goal: Protect Water Quality
B: prevent soil erosion

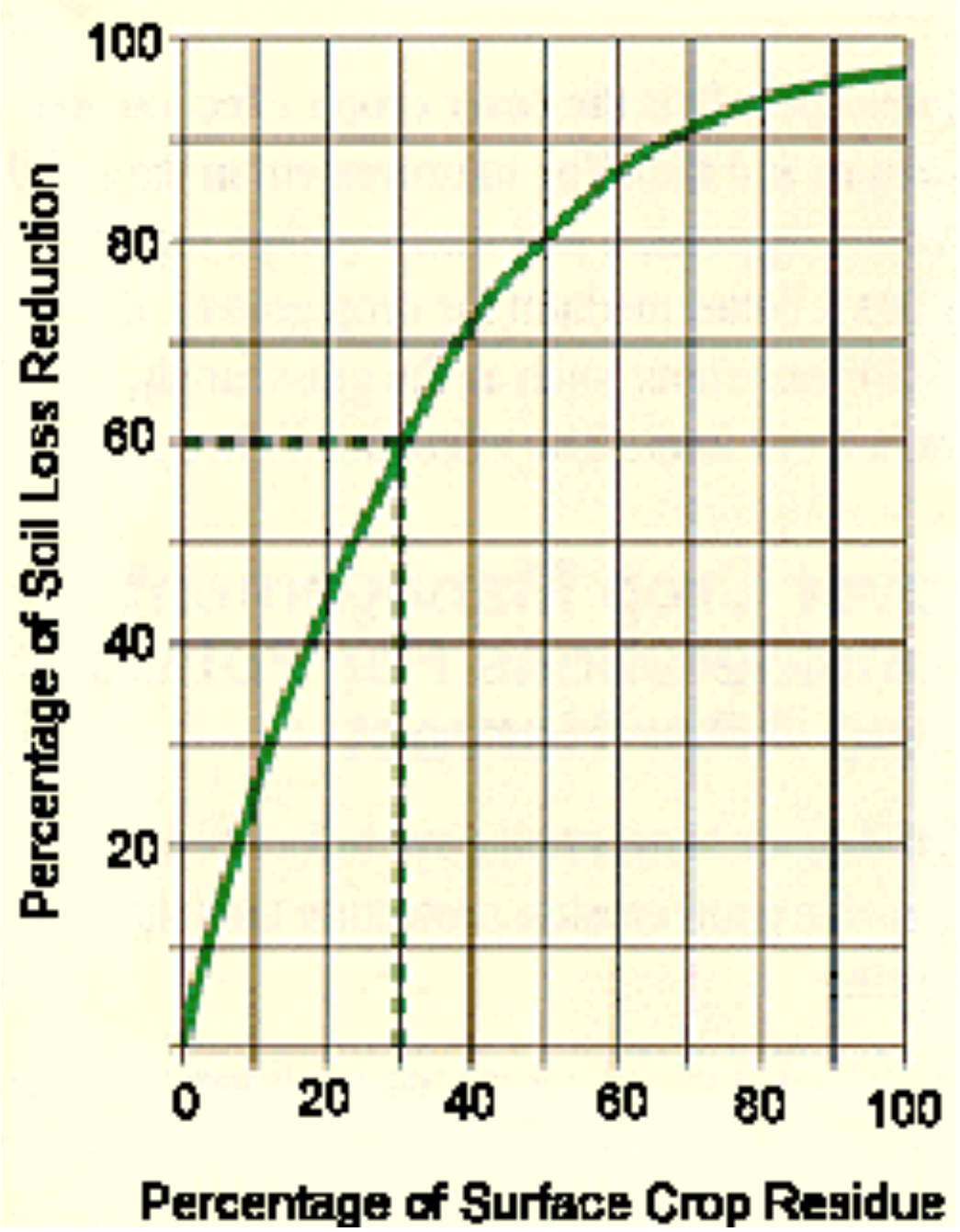
- **choose a species that rapidly covers the soil surface**
- **many of the species that are good nutrient scavengers also provide excellent ground cover.**
- **but... while annual rye grass is a good nutrient scavenger, it has fine leaves and is slow to cover the soil surface, and not a good selection for reducing erosion.**

cover the soil surface with plant residues



from Gruver

Importance of ground cover for reducing erosion



Adapted from Laflin and Colvin 1981

- https://www.youtube.com/watch?v=09k8gOSLO9k
- **Start at 40 seconds and then again at 6:10 and then 11:35**