The Superheroes of the Soil

Cover crops prevent erosion and increase infiltration

SARE
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Research & Education

Objectives

- **Understand** how cover crops can increase water infiltration
- **Explore the science** behind why cover crops are well known for their ability to prevent soil erosion
- **Hear what farmers say** about these topics and identify the management strategies that work for them

Photo by Edwin Remsberg

Defining the Challenge

Exploring a Solution

Cover crops are tools to keep the soil in place and improve water quality.

Photo by Edwin Remsberg

Why plant cover crops?

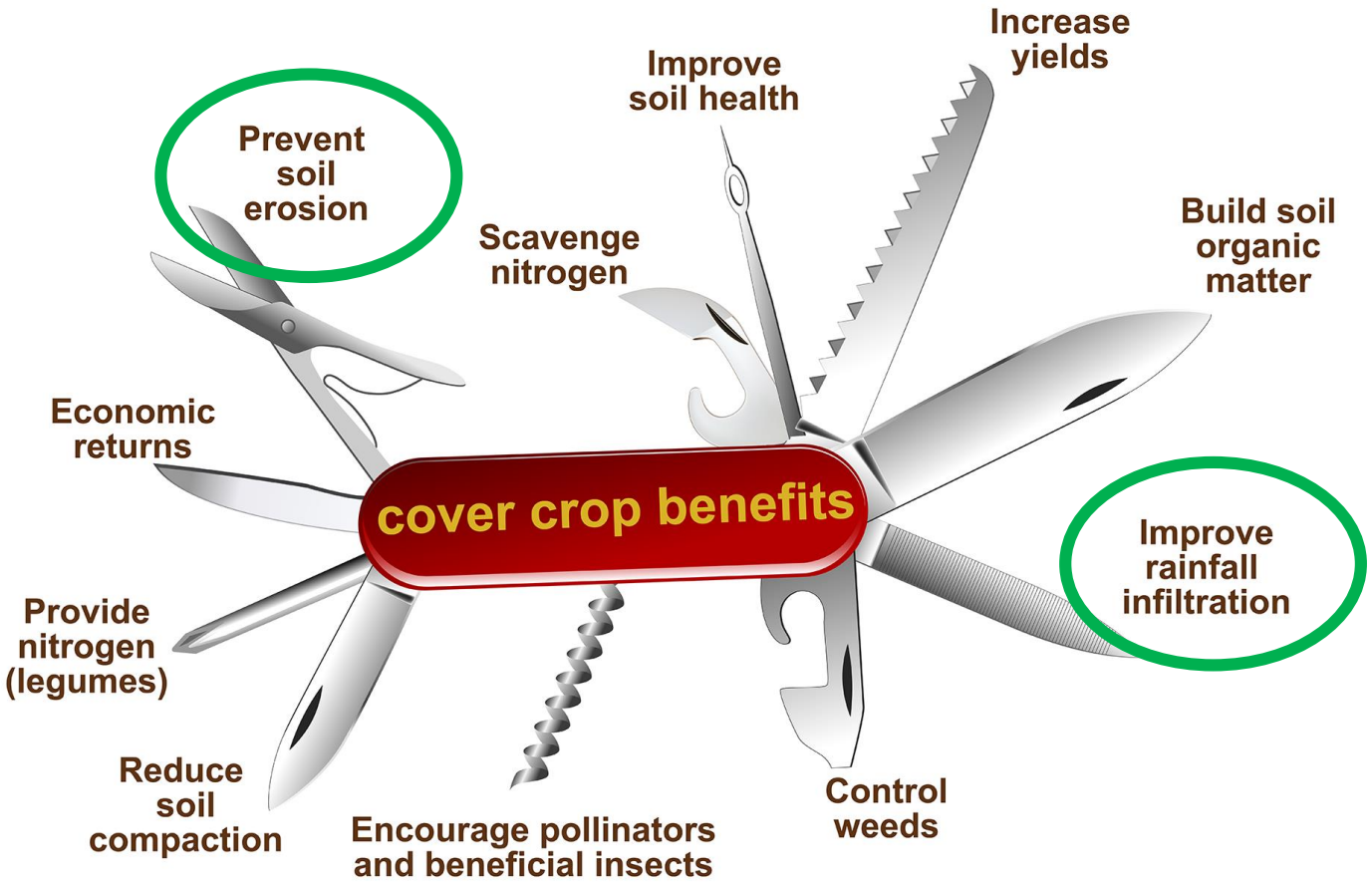


Illustration by Carlyn Iverson

What does the science say?

What are cover crop impacts on soil loss and water infiltration?

- Literature review & synthesis of 35 scientific sources
- 20 species of cover crops represented

Impact on infiltration?

Median increase in infiltration with cover crops: 92%

Mean increase: 134%

Photo: Edwin Remsberg

What about cash crop residue?

Soil surface cover by residue alone increased infiltration by a median value of 61%.

Residue can’t work alone – living root growth plays a role, too.

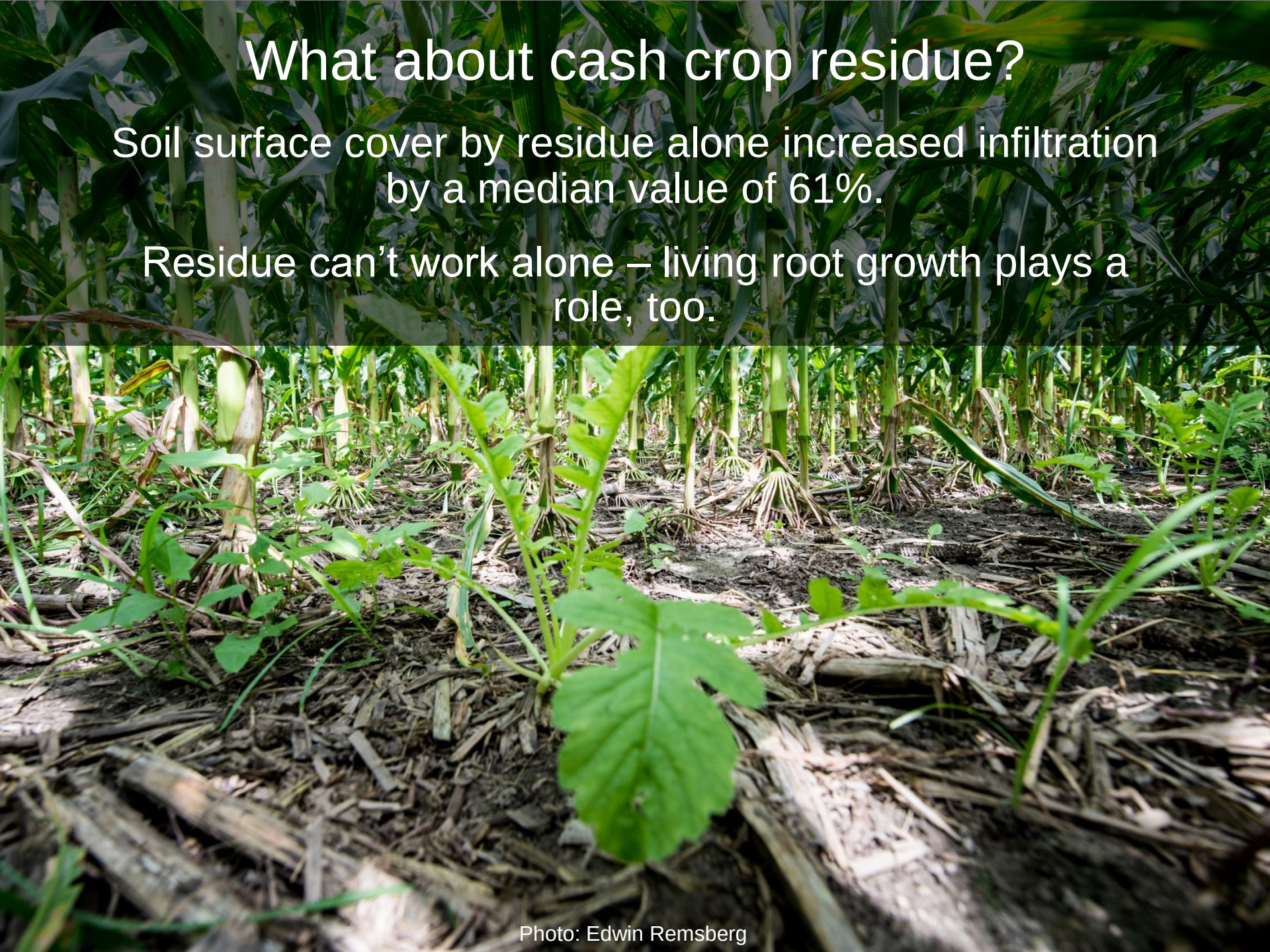
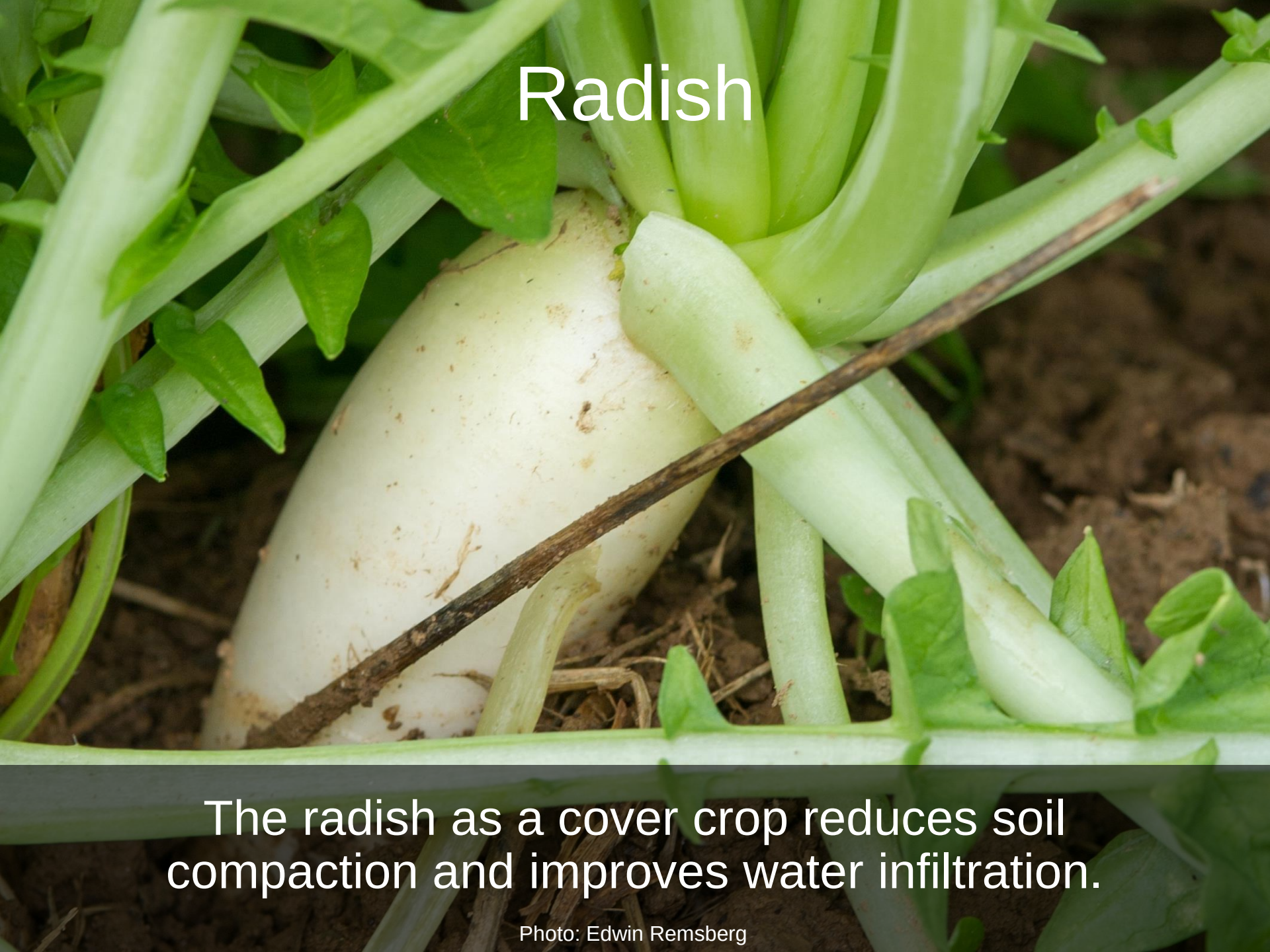


Photo: Edwin Remsberg

How do they do it?

- Prevent soil surface sealing
- Improve soil aggregate stability, soil macroporosity and available water storage capacity
- Feed soil biology – including earthworms
- Reduce soil compaction

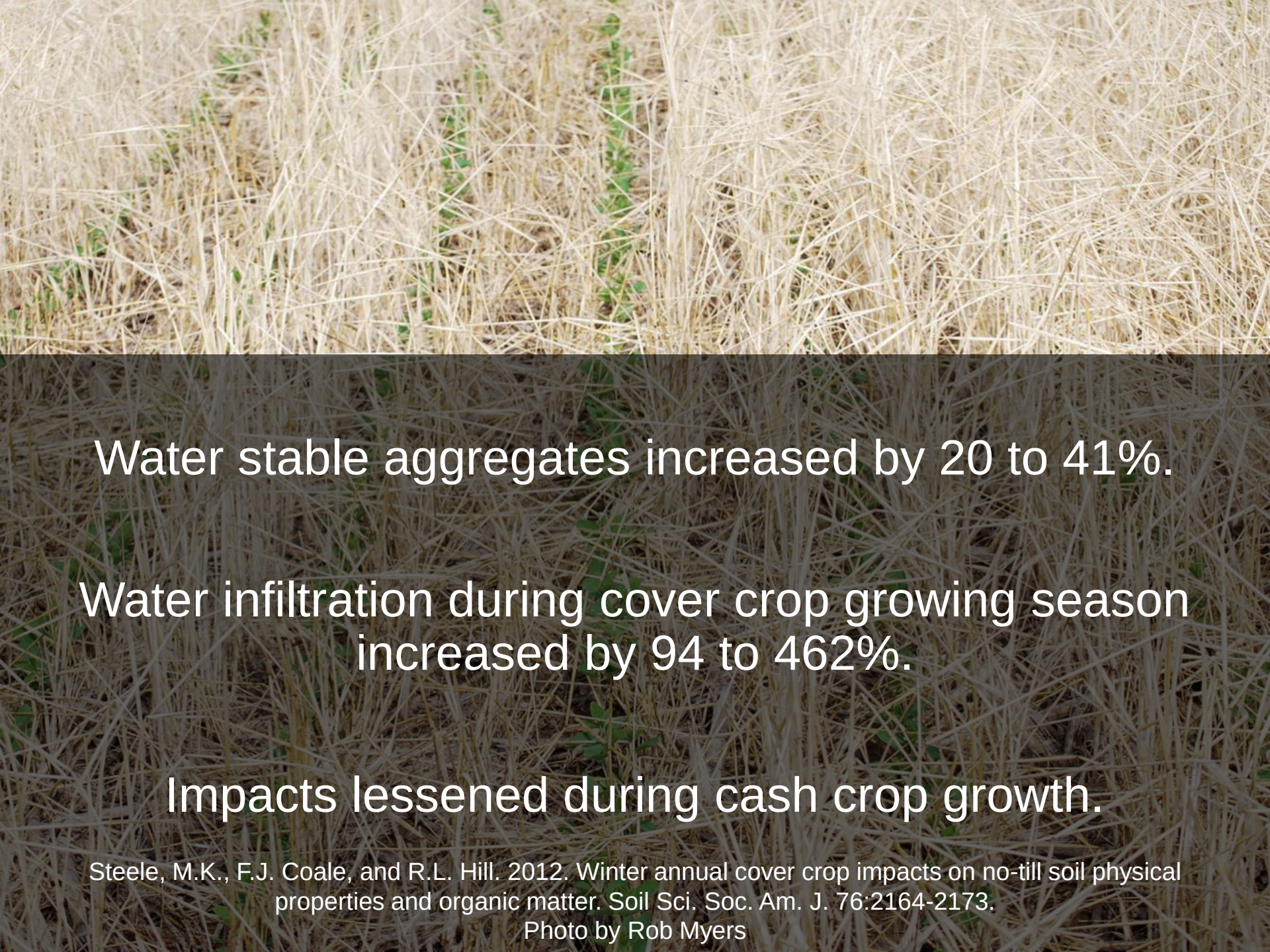
Photo: Edwin Remsberg


Radish
The radish as a cover crop reduces soil compaction and improves water infiltration.
Photo: Edwin Remsberg

Winter annual cover crop impacts on no-till soil properties

- Steele et al. (2012)
- No-till corn production in Maryland
- Trials with and without a winter cereal rye cover crop
- 13-years
- Samples in January and June
- Water infiltration to 7-cm tested

Steele, M.K., F.J. Coale, and R.L. Hill. 2012. Winter annual cover crop impacts on no-till soil physical properties and organic matter. Soil Sci. Soc. Am. J. 76:2164-2173.



Water stable aggregates increased by 20 to 41%.

Water infiltration during cover crop growing season increased by 94 to 462%.

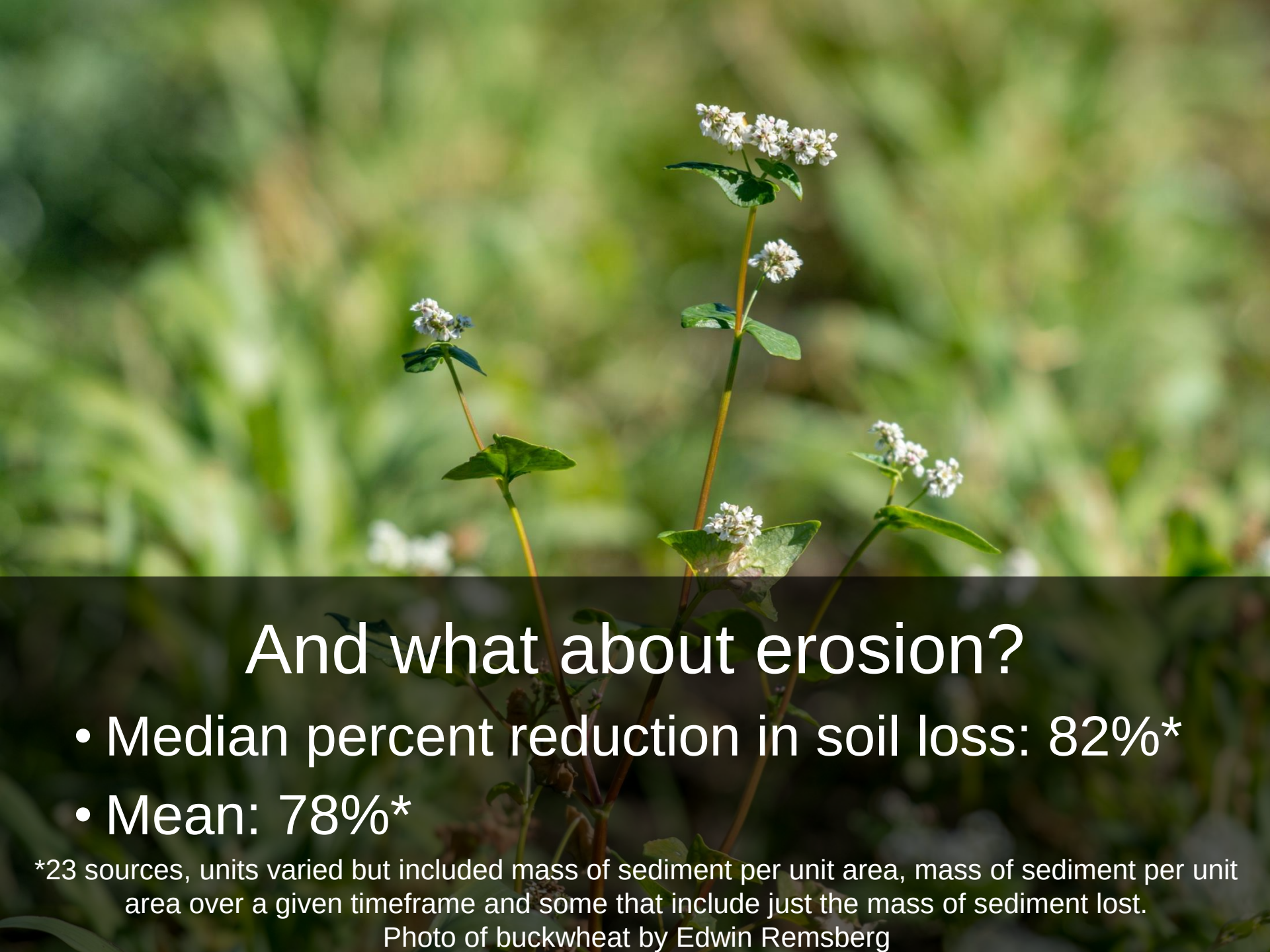
Impacts lessened during cash crop growth.

Steele, M.K., F.J. Coale, and R.L. Hill. 2012. Winter annual cover crop impacts on no-till soil physical properties and organic matter. Soil Sci. Soc. Am. J. 76:2164-2173.

Photo by Rob Myers

Increased water infiltration = reduced runoff

= reduced erosion risk



And what about erosion?

- Median percent reduction in soil loss: 82%*
- Mean: 78%*

*23 sources, units varied but included mass of sediment per unit area, mass of sediment per unit area over a given timeframe and some that include just the mass of sediment lost.

Photo of buckwheat by Edwin Remsberg

Non-legume cover crops, including cereal rye, were found to reduce soil loss by 30 to 100%.

Photo: Edwin Remsberg

Legume cover crops, like crimson clover, reduced soil loss by 40 to 70% compared to no cover crops.

Photo: Rob Myers

Mustard, a brassica, reduced soil loss by up to 82%.

Photo: Edwin Remsberg

Replacing fallow with cover crops

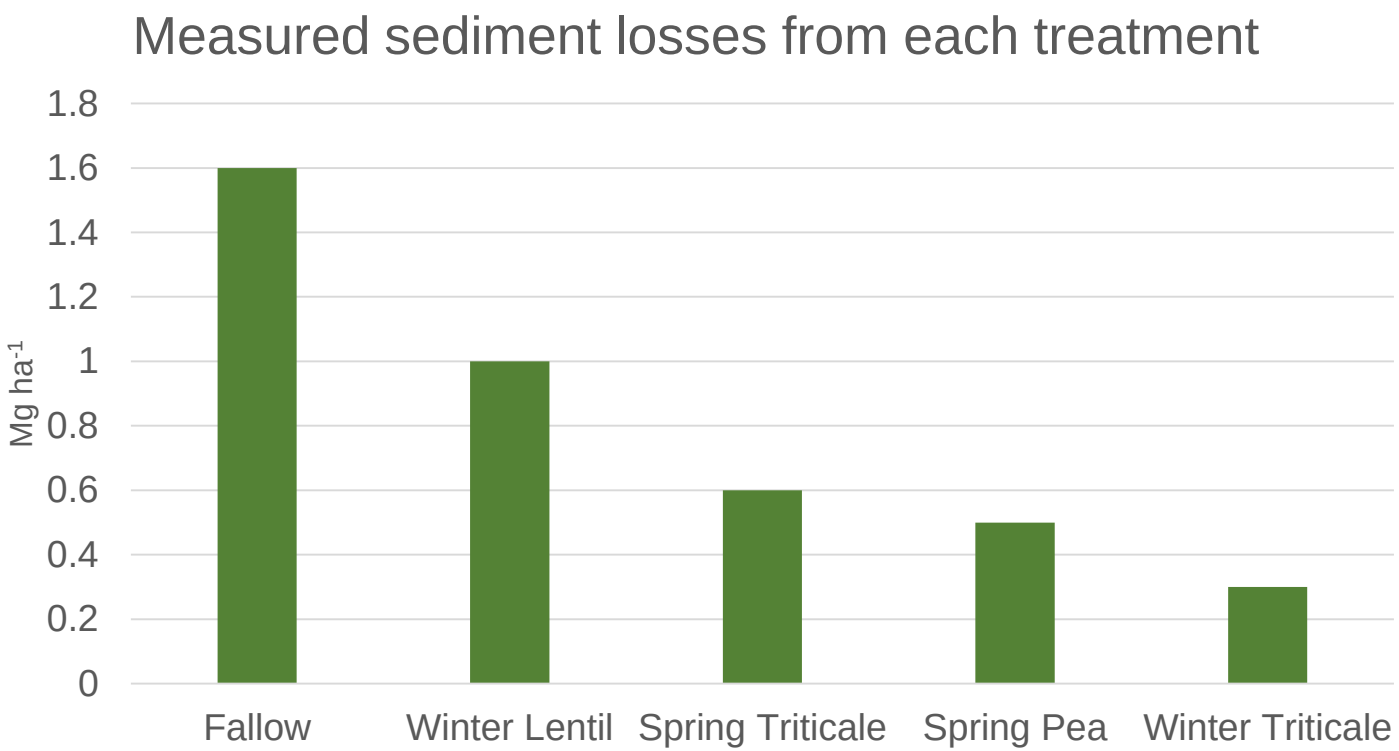
- Blanco-Canqui et al. (2013)
- Winter wheat production

in the Great Plains

- 5-year study
- No-till system
- Cover crops used: yellow sweetclover, winter triticale, winter lentil, spring lentil, spring pea, spring triticale

Blanco-Canqui, H., J.D. Holman, A.J. Schlegel, J. Tatarko, and T.M. Shaver. 2013. Replacing fallow with cover crops in a semiarid soil: effects on soil properties. Soil Sci. Soc. Am. J. 77:1026-1034

Replacing fallow with cover crops



38 to 81% reduction in sediment losses with cover crops

Impacts lessened over time

Blanco-Canqui, H., J.D. Holman, A.J. Schlegel, J. Tatarko, and T.M. Shaver. 2013. Replacing fallow with cover crops in a semiarid soil: effects on soil properties. Soil Sci. Soc. Am. J. 77:1026-1034

How do they do it?

Reduce raindrop impact and risk of soil detachment and transport

- Encourage rainfall infiltration to the soil profile, reducing runoff
- Cover and protect soil surface from erosive forces
- Slow water flow on soil surface
- Roots anchor into the soil profile and hold biomass and soil in place

Photo: Edwin Remsberg

Combining Management Strategies: Tillage

- Conservation tillage practices were responsible for an **89% reduction in soil loss** as compared to conventional tillage practices.

Photo: Edwin Remsberg

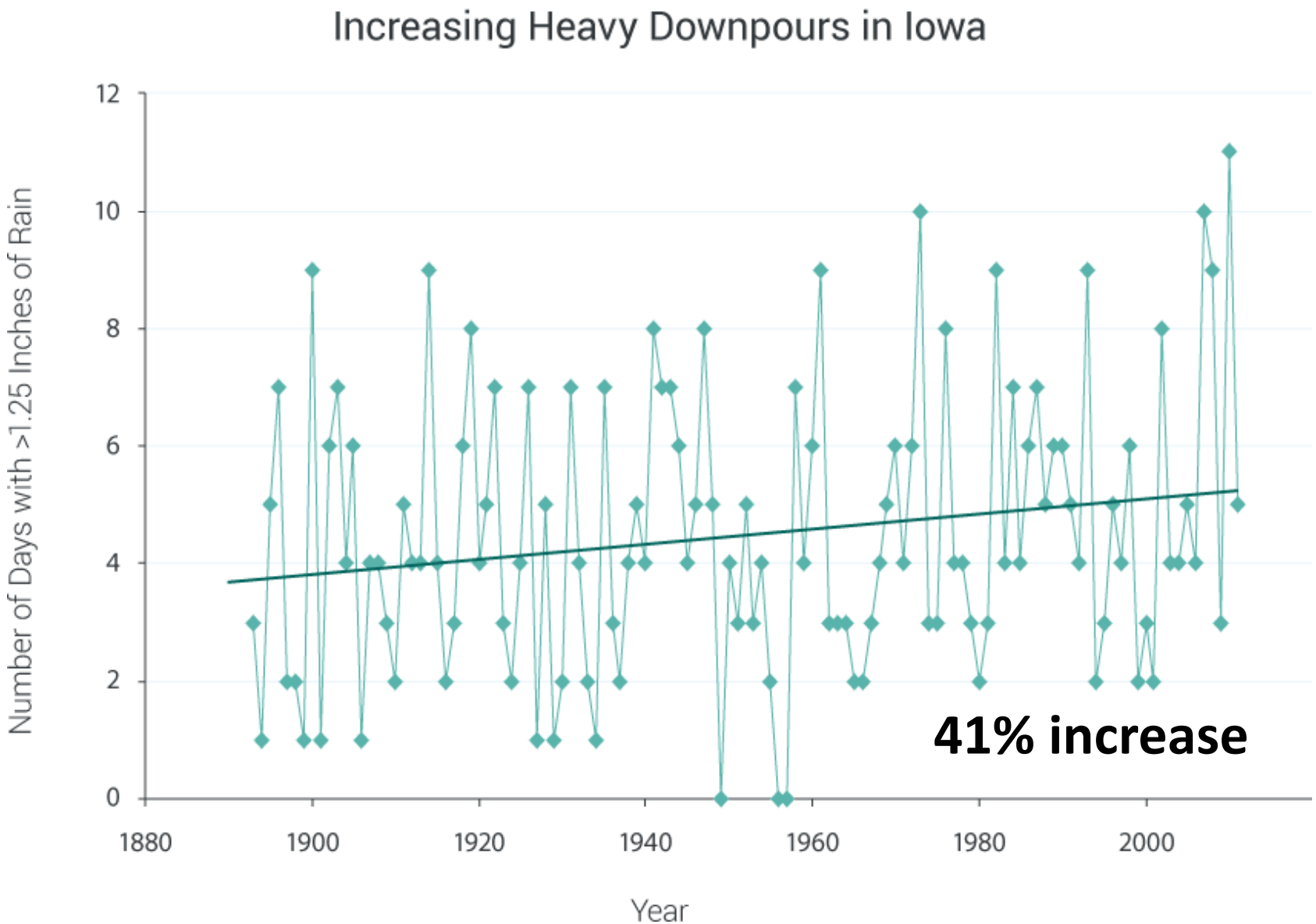
From theory to practice: what do farmers and ranchers say?

Photo: Edwin Remsberg

Ray Gaesser, Iowa

- 5,500 acres
- Corn-soybean, no-till
- 2,500 to 3,000 acres of cereal rye cover crop
- Terraces, cover crops, tile drainage

The greatest impacts of Ray's management decisions can be seen during extreme rainfall events.



National Climate Assessment. Retrieved from: http://nca2014.globalchange.gov/report/sectors/agriculture#narrative-page-16370 on November 20, 2017; Original data from: Takle, E., 2011: Ch. 2: Climate changes in Iowa. *Climate Change Impacts on Iowa 2010*,, Iowa Climate Change Impacts Committee, Iowa Department of Natural Resources, 8-13.

Noah Williams, Oregon

- Winter wheat, chem-fallow
- 2,800 acres
- 60 acres of cover crops
- Triticale, oats, turnips, forage collards, winter peas, common vetch, safflower, sunflower and phacelia

Reduced wind erosion risk

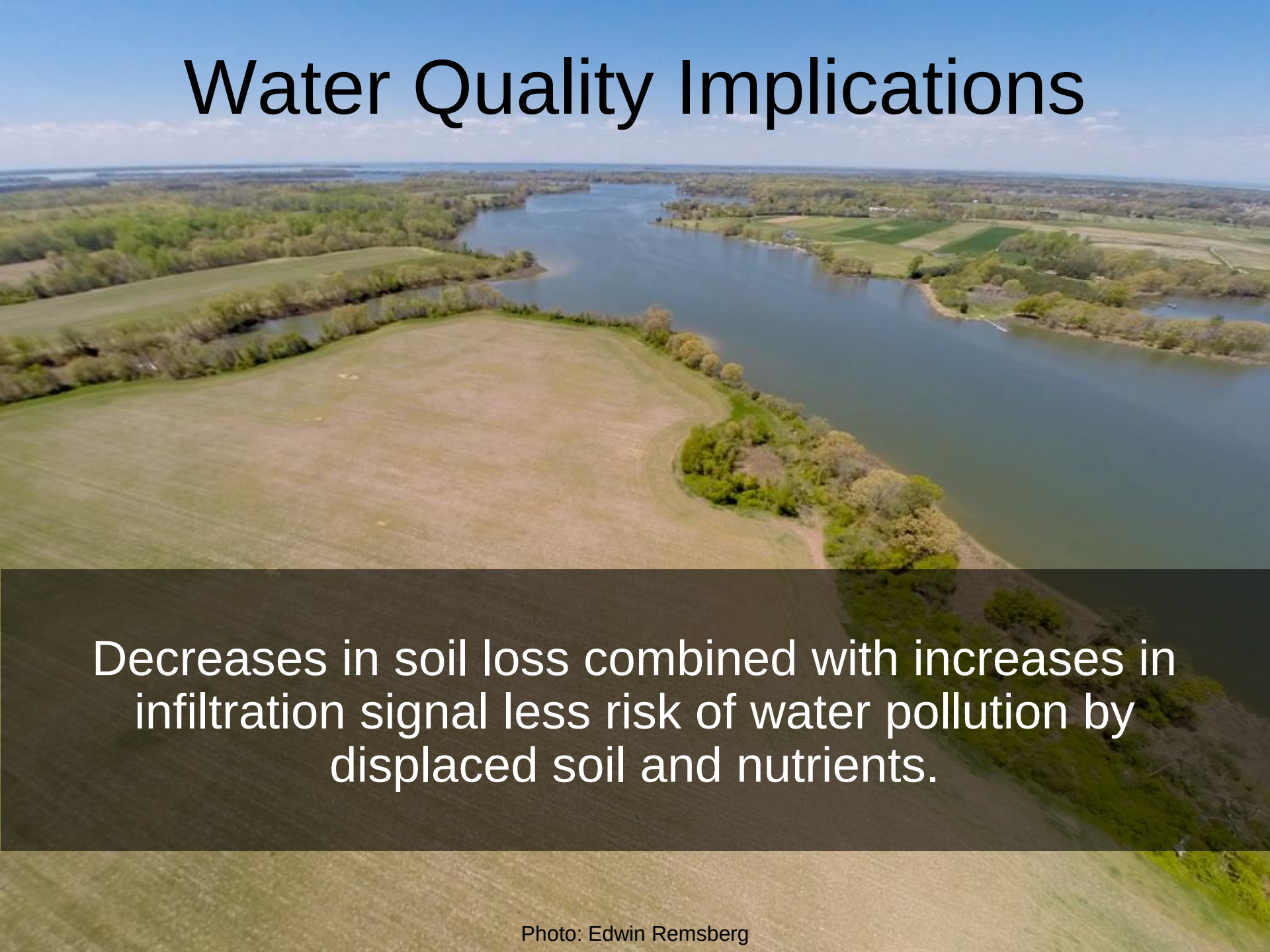
Soil under cover crops supported root growth beyond the plow pan (6 to 8 inches) – **signaling reduced compaction.**

Cover crop trials saw immediate infiltration, while rainfall in the control was slow to percolate beyond the first 6-inches.

Cover cropped fields pick up moisture at depths of one to two feet whereas control does not.

Noah Williams & Garrett Duyck (NRCS, OR)

Water Quality Implications



Decreases in soil loss combined with increases in infiltration signal less risk of water pollution by displaced soil and nutrients.

Photo: Edwin Remsberg

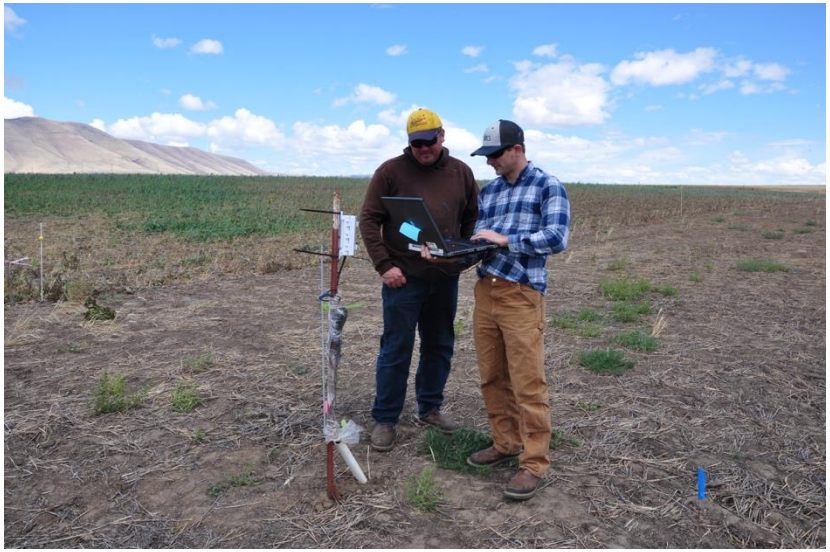
Takeaways

- Cover crops are proven to prevent soil erosion and increase rainfall infiltration, which ultimately can improve water quality.
- Farmers across the country are seeing this on their own fields.
- To truly achieve these benefits, the best management strategy is to **maintain residue coverage, encourage year-round living roots and have minimal soil disturbance.**

Photo: Edwin Remsberg

The True Superheroes of the Soil

The farmers and ranchers using conservation agriculture approaches on their land, and the researchers and conservationists working with them.



Thank you Noah, Garrett and Ray!

And thanks to Rob Myers and Tom Kaspar!

Resources

- Resources available at the SARE Cover Crop Topic Room:
  - Cover Crops and Water Quality Resource Series: http://www.sare.org/Learning-Center/Topic-Rooms/Cover-Crops/Cover-Crops-and-Water-Quality-Resource-Series
  - Explore cover crop impacts on soil and sediment loss, nutrient losses, water infiltration and soil organic matter
  - Soil health and cover crop illustrations
  - PowerPoint presentation templates
  - Books, bulletins, fact sheets on soil health and cover crops

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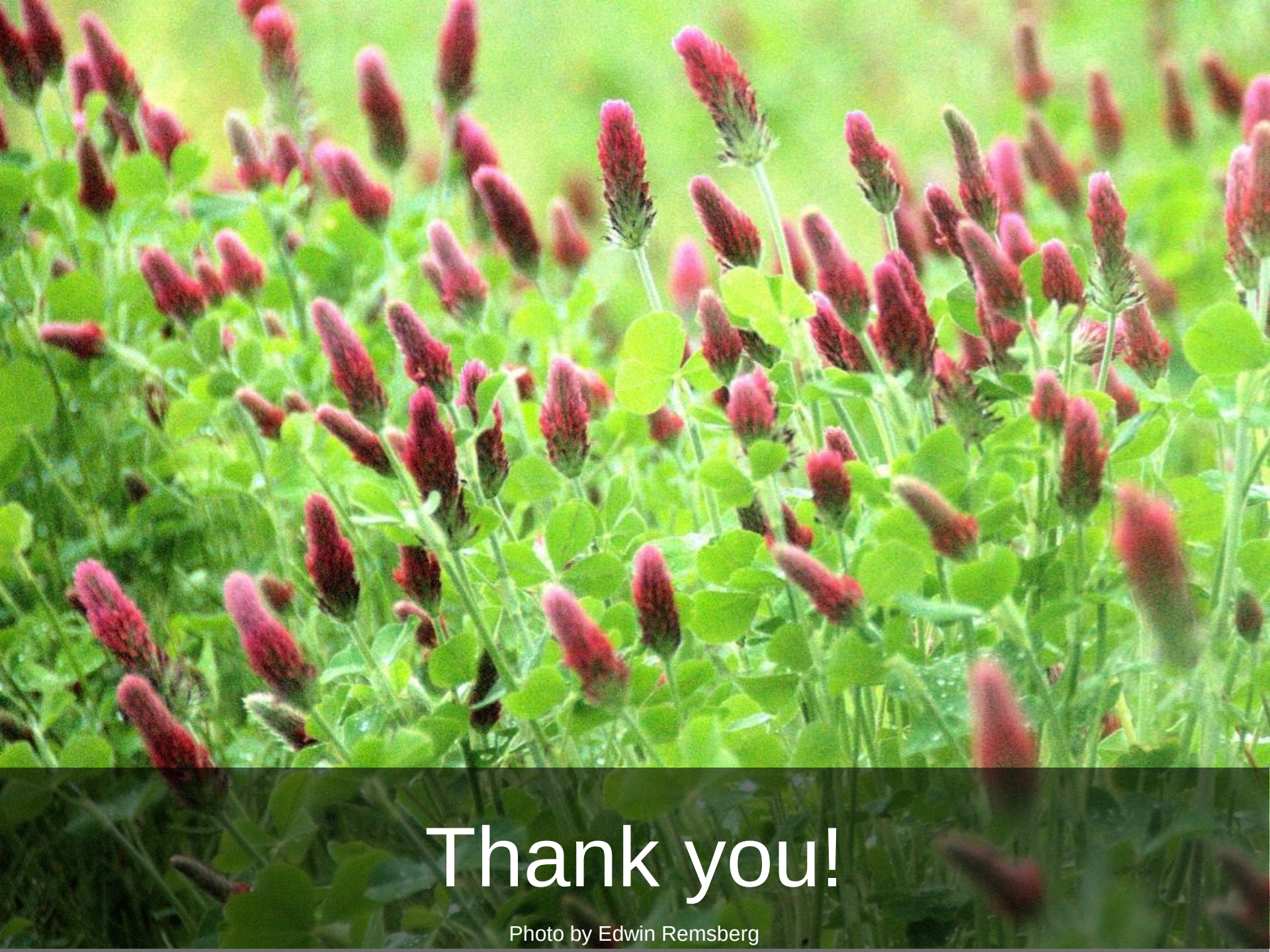

Thank you!

Photo by Edwin Remsberg