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Cover crops, soil health, climate change

13 April 2019 Dean Moberg, NRCS

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Soil School 2019



Cover crops Soil health Climate change

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USDA - NRCS

- **SCS, 1935**
- **NRCS, 1994**
- **SWCDS**



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Overview

1. Carbon and nitrogen
2. Resilient, healthy soil
3. Cover crop choices



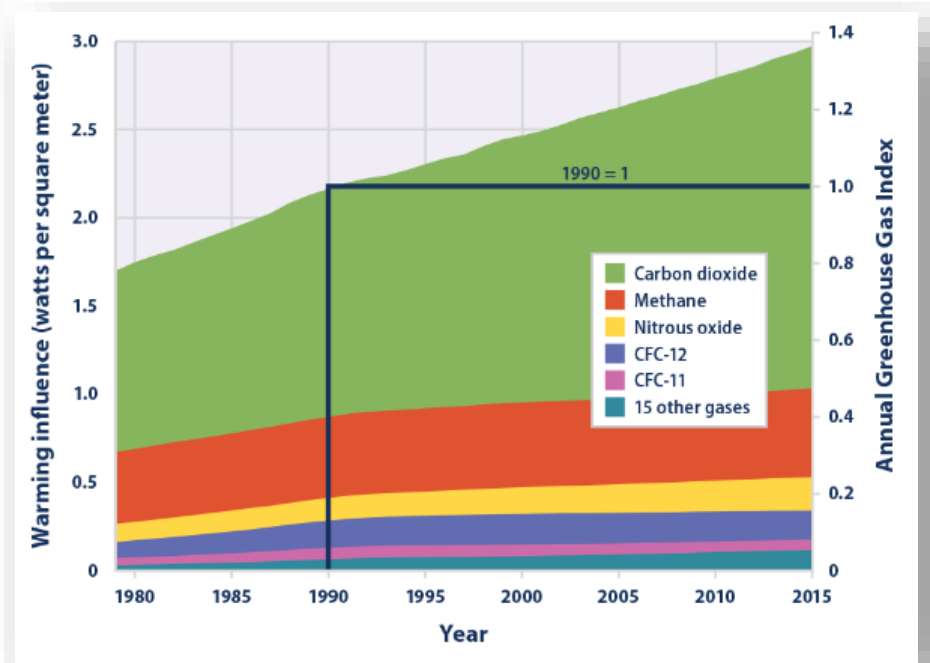
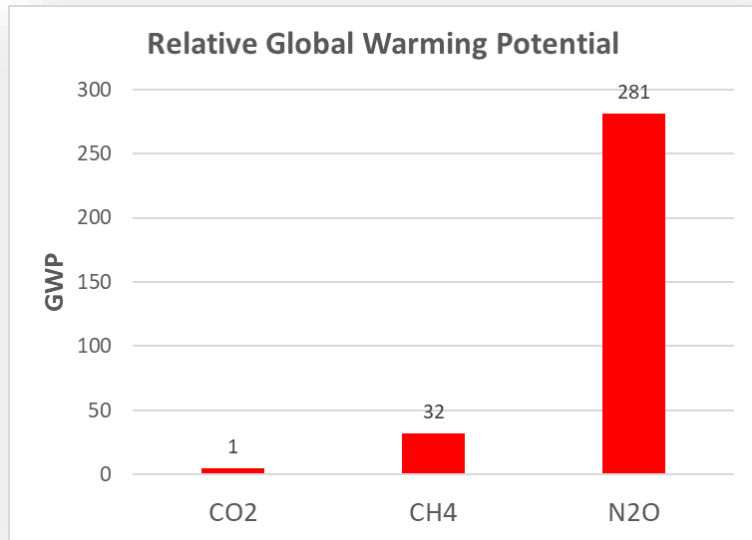


1. Carbon and nitrogen

- CO_2 - carbon dioxide
- CH_4 - methane
- N_2O - nitrous oxides



Van Heemskerck,
An Alchemist or Apothecary in His Lab



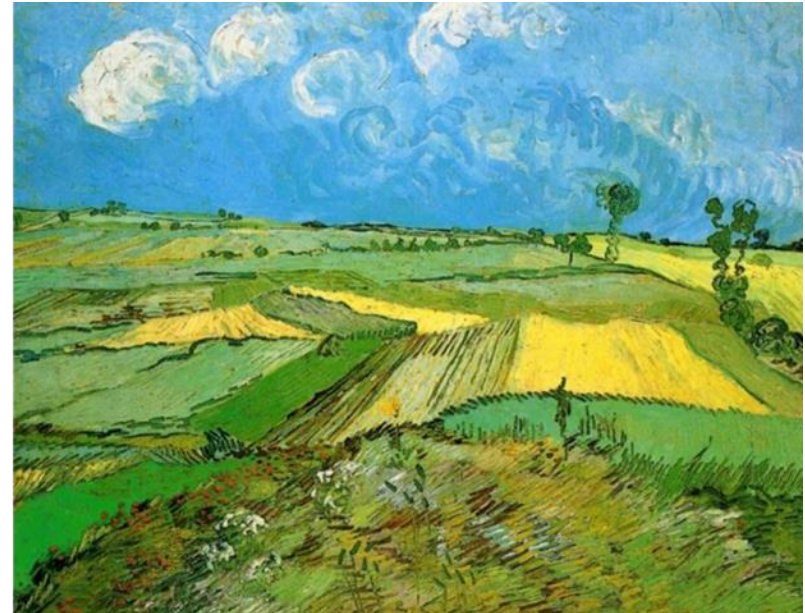
EPA, NOAA



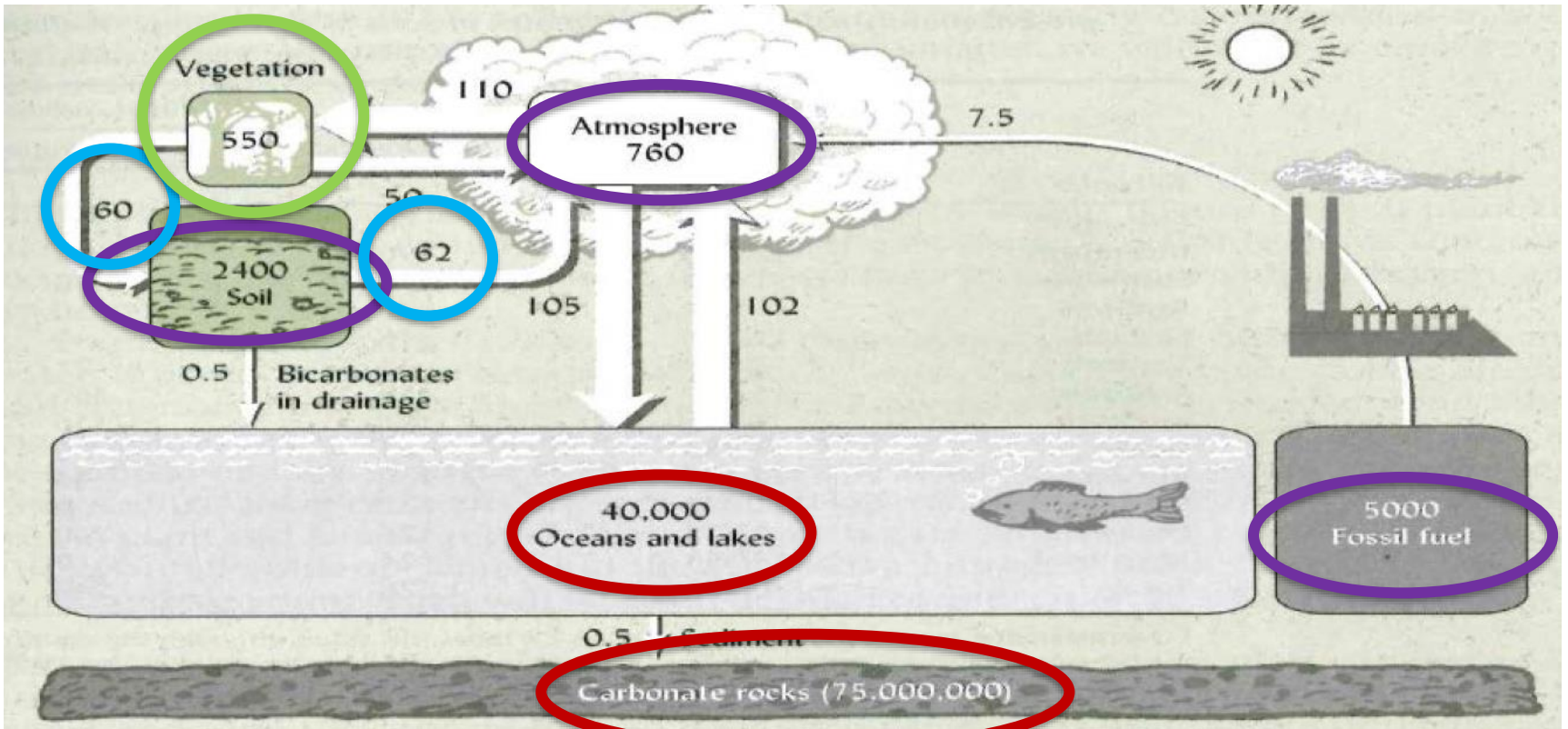
Focus on cover crops and CO₂

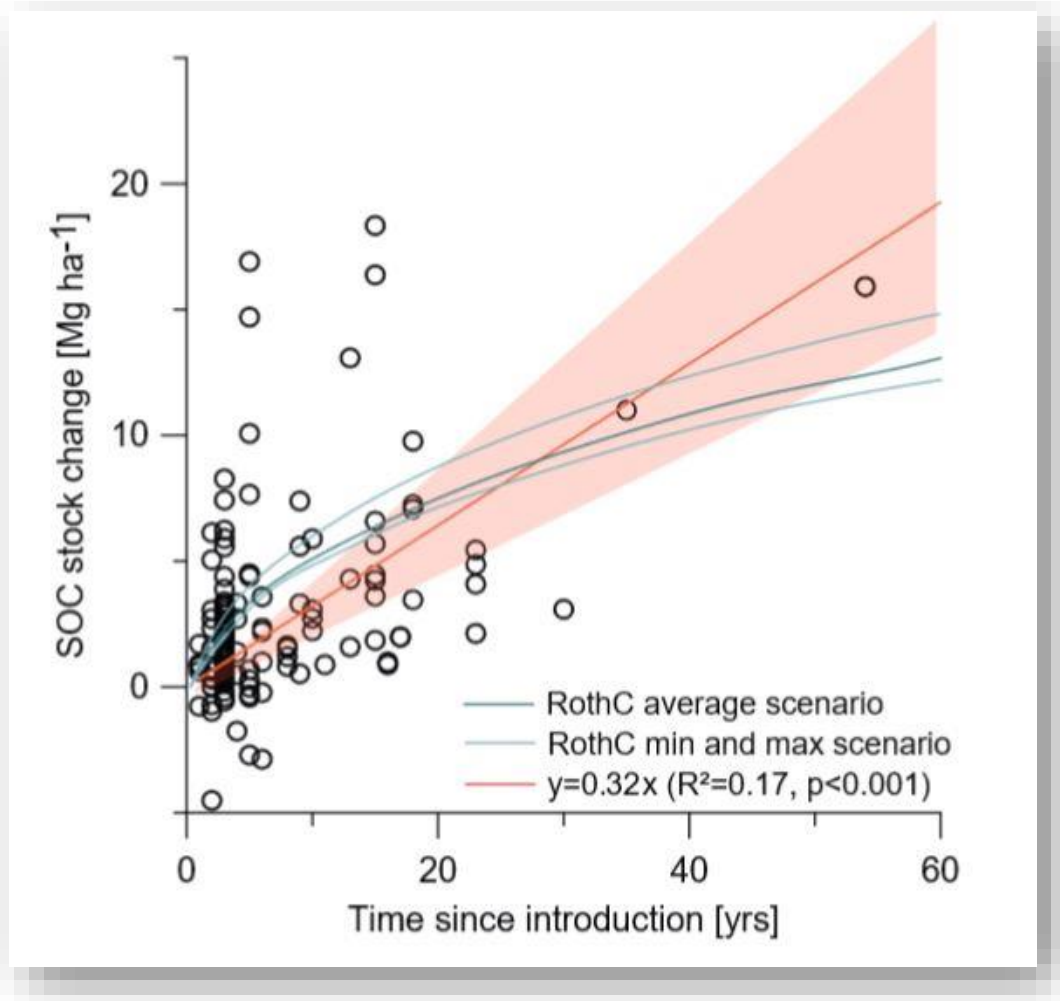
- CO₂ = largest warming influence globally
- CO₂ = largest impact by most farms

- Cover crops *may* reduce N₂O (minor)
- Cover crops don't affect CH₄ (unless grazed by ruminants)



Van Gogh,
Wheat Fields at Auvers





Cover crops capture carbon...



...which helps reduce climate change.

2. Cover crops and resilient soil



Schiros, *Roots*

Cover crops make soil resilient



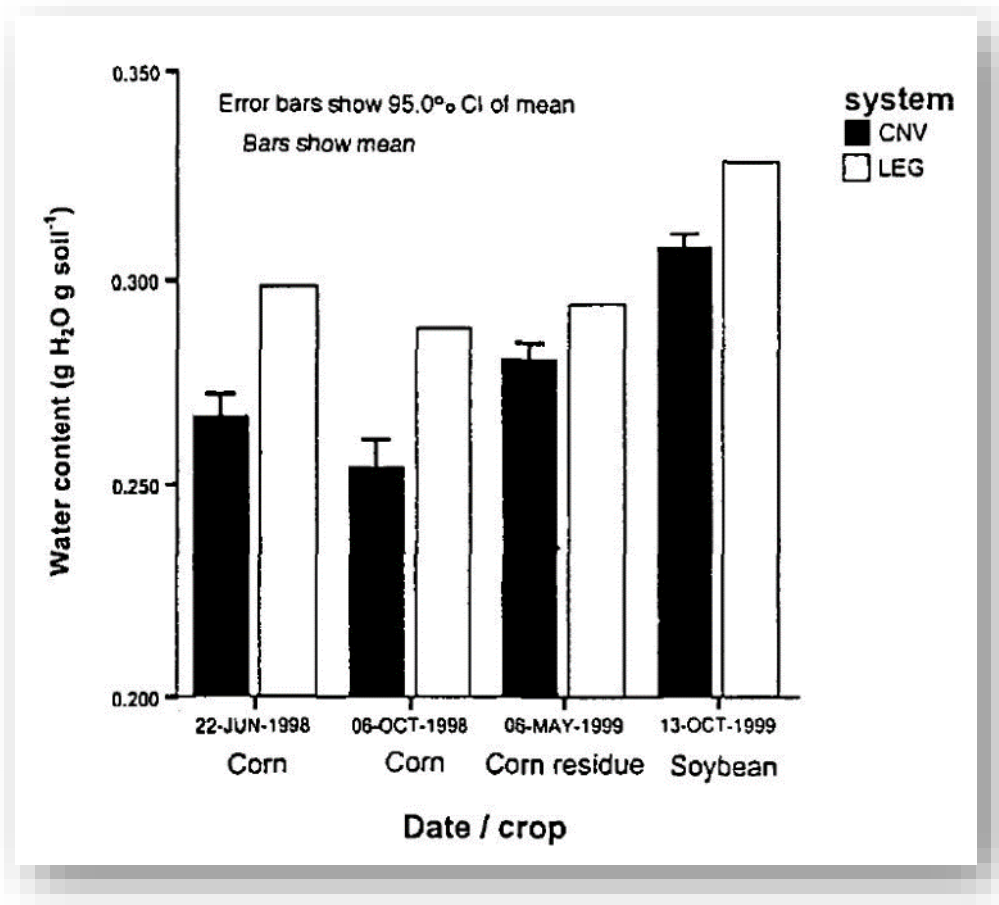
- **Increased organic matter**
- **Better water infiltration and storage**
- **Less “leaky” nutrient cycles**
- **More diverse soil organisms**



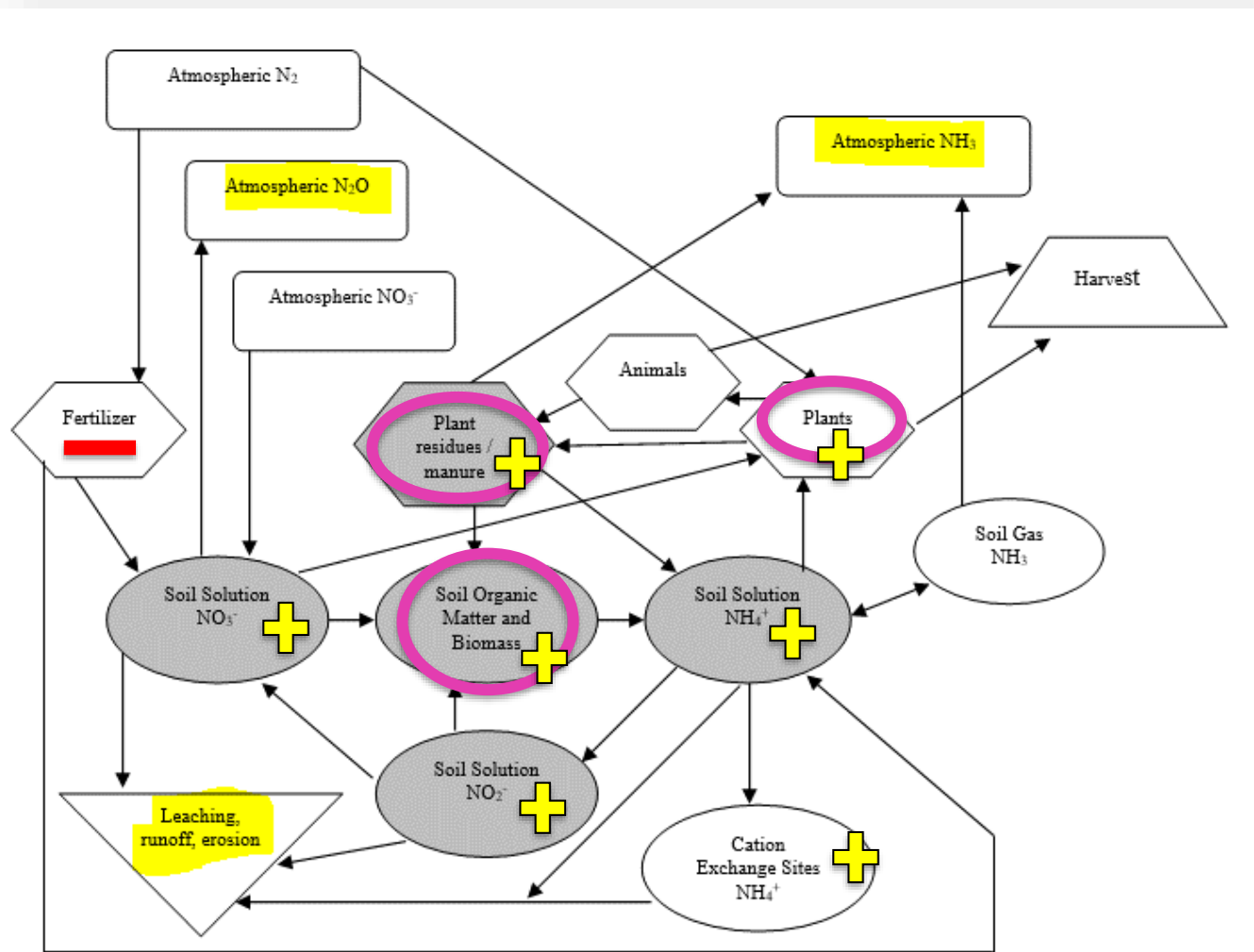
Increase organic matter



Better water infiltration and holding capacity



Less leaky nutrient cycles



Less leaky nutrient cycles



More diverse soil organisms



Functional group	Function	Representative members
Chemical Engineers	Regulate 90% of energy flow in soil	Soil microbes (bacteria, archaea, fungi, protozoa)
Biological Regulators	Regulate populations of other soil organisms	Protozoa and small invertebrates (e.g., nematodes, pot worms, springtails, mites)
Ecosystem Engineers	Build pore networks and aggregates Redistribute soil particles, microbes, & organic matter	Plant roots, earthworms, and other larger invertebrates (e.g., millipedes, centipedes, beetles, caterpillars, scorpions)

Cover crops make soil resilient...



...and help crops cope with climate change

3. Cover crop choices



Vonnoh, *Coquelicots*

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Diversifying cover crop mixes

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About 767,000 results (0.43 seconds)

Cover Crop Chart : USDA ARS

<https://www.ars.usda.gov/plains-area/mandan-nd/ngprl/docs/cover-crop-chart/> ▼

Jun 29, 2018 - The chart, patterned after the **periodic table** of elements, includes information on 66 **crop** species that may be planted individually or in cocktail ...



Cover Crop Chart

GROWTH CYCLE	PLANT ARCHITECTURE	RELATIVE WATER USE
A = Annual	γ = Upright	● = Low
B = Biennial	* = Upright-Spreading	●● = Medium
P = Perennial	≡ = Prostrate	●●● = High

COOL			BROADLEAF						WARM	
--GRASS--									--GRASS--	
A ● ANNUAL FESCUE γ									A ● BROWNTOP MILLET γ	
A ● BARLEY γ									A ● FOXTAIL MILLET γ	
			----- LEGUME -----							
A ●● OAT γ	A/B ● CAMELINA γ	A/P ● MUSTARD *	A ● BALANSA CLOVER ≡*	A ● CHICKPEA *	A/P ● MEDIC γ	A ● COWPEA *	A ● CLUSTER BEAN *	A ●● AMARANTH γ	A ● PEARL MILLET γ	
A ● SPELT γ	A ● PHACELIA γ	A/B ●● CANOLA *	A ●● BERSEEM CLOVER γ	A ● PEA γ	A ● LUPIN γ	A/P ● LABLAB ≡*	A/P ● JACK BEAN *	A ●● BUCKWHEAT γ	A ●● PROSO MILLET γ	
A ● WHEAT γ	A ●● FLAX γ	A ●●● RADISH *	A ●● CRIMSON CLOVER *	A ● LENTIL *	A ●● FABA BEAN γ	A/P ● FENUGREEK γ	A ● VELVET BEAN *	P ●● CHICORY *	A ●● GRAIN SORGHUM γ	
A ●●● CEREAL RYE γ	A ●● KALE *	B ●●● TURNIP *	B/P ●● RED CLOVER γ	A/P ●● LESPEDEZA ≡*	A/B ●● SWEET CLOVER γ	A/P ● PIGEONPEA *	A ●● MUNG BEAN *	A ●●● CUCURBITA ≡	A ●● SUDAN GRASS γ	
A ●● TRITICALE γ	A ●● SPINACH *	B ●●● BEET *	P ●● WHITE CLOVER ≡*	P ●● BIRDSFOOT TREFOIL ≡	P ●● ALFALFA γ	A ●● PARTRIDGE PEA γ	A ●● SOYBEAN *	A ●●● SAFFLOWER γ	A ●● TEFF γ	
P ● SALINE TOLERANT γ	A/B ●●● CHARD *	A/B ●●● CARROT *	P ●● KURA CLOVER ≡	A/B ●● VETCH ≡	P ●●● SAINFOIN γ	A ●● SUNNHEMP γ	A/P ●●● PEANUT ≡*	A ●●● SUNFLOWER γ	A ●●● CORN γ	



pnw cover crop selection tool



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About 192,000 results (0.45 seconds)

Pacific Northwest Cover Crop Selection Tool | NRCS Plant Materials ...

<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/.../toolsdata/plant/?cid...> ▼

Pacific Northwest Cover Crop Selection Tool. This **Cover Crop Selection Tool** for Idaho, **Oregon**, and Washington is intended as a guide to help growers and conservation planners **select cover crop** species adapted to their climate, soils, and the purposes of the **cover crop**.

[Start the Cover Crop Selection Tool](#)

Pacific Northwest Cover Crop Selection Tool

Precipitation Zone	<input type="text" value="Irrigated"/>
Plant Type	<input type="text" value="Cool season"/>
Overwinter?	<input type="text" value="Yes"/>
Hardiness Zone	<input type="text" value="8"/>
Soil Drainage Class	<input type="text" value="Well drained"/>
Soil pH Class	<input type="text" value="Moderately acidic (pH 5.6 - 6.5)"/>
Soil Salinity Class	<input type="text" value="Not saline (EC less than 2 mmhos/cm)"/>
Ponding Class	<input type="text" value="Not frequently ponded"/>
Purpose 1	<input type="text" value="Increase organic matter"/>
Purpose 2	<input type="text" value="Promote nitrogen fixation"/>
Purpose 3	<input type="text"/>
Purpose 4	<input type="text"/>

Cover Crop Adapted Species and Selected Purposes Ratings Report

Clear all Selections

Cover Crop Adapted Species and All Purposes Ratings Report

Clear Purposes 2-4

Cover Crop Adapted Species and Plant Properties Report

Run all Reports

Cover Crop Adapted Species and Seeding Information Report

Close all Reports

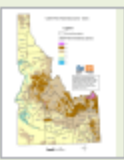
Web Link - Plant Materials Technical Note 41 - Cover Crop Resources and Seed Vendors for Oregon and Washington

Double click on an image below to open a State Hardiness Zone Map

Idaho

Oregon

Washington



Suitable Cover Crop Species and Selected Purpose Rating

4/9/2019

Precipitation Zone: Irrigated

Soil Drainage Class: Well drained

Planting Season: Cool season

Soil pH Class: Moderately acidic (pH 5.6 - 6.5)

Overwinter: Yes

Soil Salinity Class: Not saline (EC less than 2 mmhos/cm)

Hardiness Zone: 8

Ponding Class: Not frequently ponded



Plant Name	Purpose 1: Increase organic matter	Purpose 2: Promote nitrogen fixation	Purpose 3: None selected	Purpose 4: None selected
arugula (5)	Fair	Poor		
barley, spring	Good	Poor		
barley, winter	Good	Poor		
canola/rapeseed, spring (1, 5)	Fair	Poor		
canola/rapeseed, winter (1, 5)	Fair	Poor		
clover, crimson (4)	Fair	Good		
clover, red (3, 4)	Fair	Good		
clover, strawberry (4)	Fair	Good		
clover, subterranean (4)	Fair	Good		
clover, white (3, 4)	Fair	Good		
fava, small seed (4, 6)	Good	Fair		
flax	Fair	Poor		
kale (1, 5)	Fair	Poor		

Plant Name	Purpose 1: Increase organic matter	Purpose 2: Promote nitrogen fixation
arugula (5)	Fair	Poor
barley, spring	Good	Poor
barley, winter	Good	Poor
canola/rapeseed, spring (1, 5)	Fair	Poor
canola/rapeseed, winter (1, 5)	Fair	Poor
clover, crimson (4)	Fair	Good
clover, red (3, 4)	Fair	Good

Plant Name	Seeds per pound	Seeding depth - min (in)	Seeding depth - max (in)	Drilled Single Species	
				Seeding Minimum	Rate - lb/ac Maximun
arugula (5)	280,000	0.25	0.5	4	6
barley, spring	13,600	1	2	50	100
barley, winter	12,800	1	2	50	100
canola/rapeseed, spring (1, 5)	125,000	0.25	0.5	3	16
canola/rapeseed, winter (1, 5)	125,000	0.25	0.5	3	16
clover, crimson (4)	130,000	0.25	0.5	15	20
clover, red (3, 4)	272,200	0.25	0.5	4	10

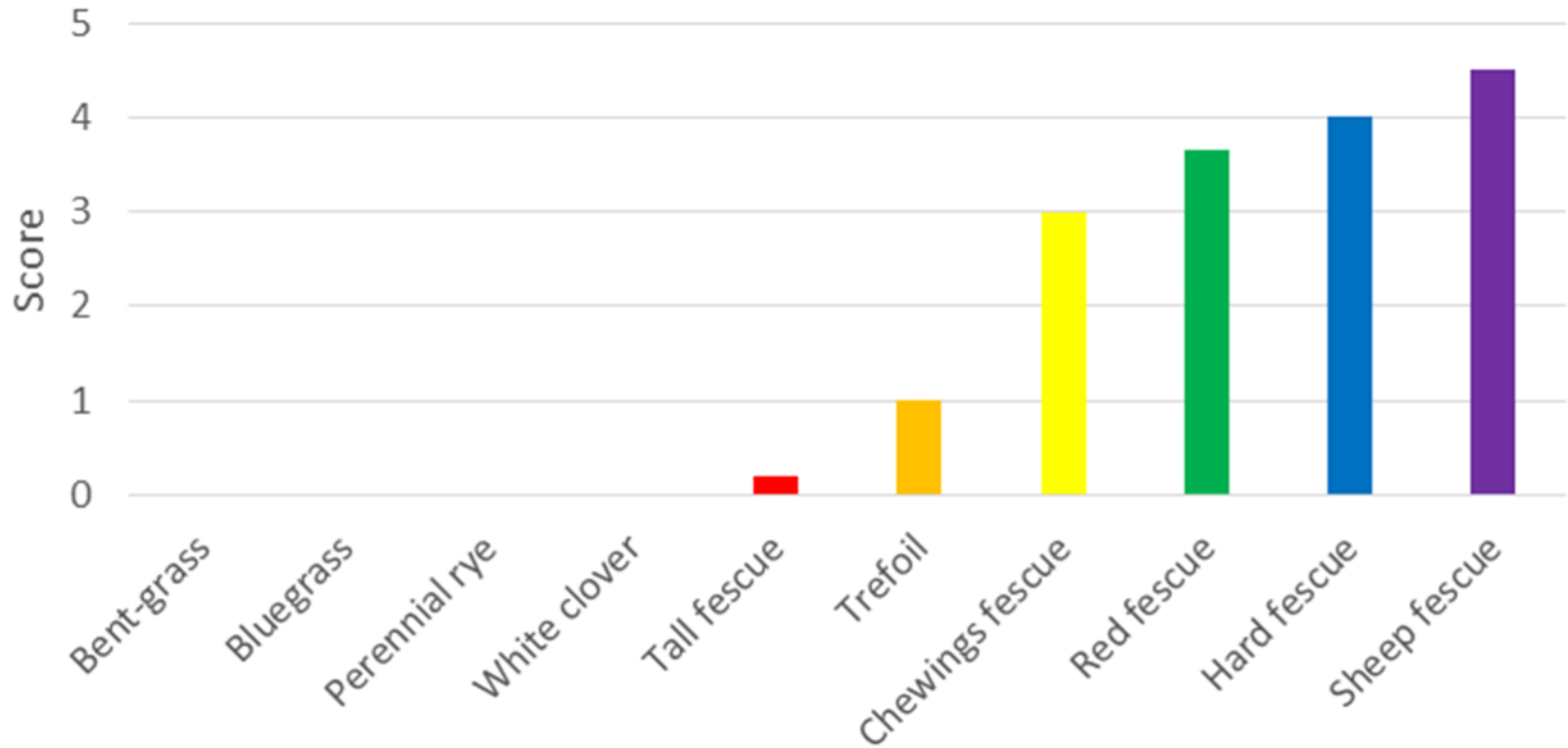
For perennial crops

- **Choose perennial covers**
- **Less labor: only seed once**
- **More carbon**





Logan Cover Trial average stand scores



20 years after seeding



How to plant

- **Mix 2 or more functional groups**
- **Seed early in fall**
- **Rough soil surface**
- **Double rate if broadcasting**
- **Harrow, rake, mulch, pack lightly**
- **Experiment!**



Van Gogh, *The Sower*



How to kill

- **Kill ~3 weeks prior to planting “cash” crop**
- **Minimize disturbance:**
 - Till lightly
 - Graze
 - Mow
 - Crimp
 - Herbicide









For more information



The screenshot shows a Google search interface. The search bar contains the text "SARE COVER CROPS" and a magnifying glass icon. Below the search bar, navigation tabs include "All" (highlighted with a blue underline), "Videos", "News", "Images", "Shopping", "More", "Settings", and "Tools". The search results section displays "About 166,000 results (0.36 seconds)". The first result is titled "Managing Cover Crops Profitably, 3rd Edition - Sustainable ..." in purple text. Below the title is a green URL: <https://www.sare.org/Learning-Center/.../Managing-Cover-Crops-Profitably-3rd-Editi...> followed by a downward arrow. The snippet text reads: "Along with detailed management information on the most commonly used species—including **grasses**, **grains**, **brassicas** and **mustards**, and **legumes**—Managing Cover Crops Profitably offers chapters on the role of cover crops in broader topics such as crop rotations, pests and conservation tillage."



For more information



NRCS SOIL HEALTH



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About 1,090,000 results (0.49 seconds)

Soil Health | NRCS Soils - USDA

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/> ▼

Soil health, also referred to as soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and ...





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