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Cover Crop Considerations for California

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https://www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials/pmc/west/capmc/

Overview

- NRCS and Soil Health Principles
- Cover Crop and Conservation Cover
- Cover Crop Selection
  - Cool season
  - Warm season
- Cover Crop Considerations
  - Planting methods, irrigation, termination
- Wrap up

Dust bowl

Severe erosion called for emergency conservation efforts…….

Soil Conservation Service

Plant Materials Program

1930s-40s:

The Dust Bowl Days

Soil Conservation Service recognized plant cover essential for preventing erosion.

Plant Materials Nurseries were formed to grow plants for windbreaks and soil conservation

1939 – Capacity to produce 150-200 million plants

Present – Seed and plant production by commercial entities. The Plant Materials Program in CA focuses on cover crop studies and information

NRCS Soil Health Principles

1. Minimize soil disturbance
2. Keep the soil covered with plant residues
3. Build diversity
4. Keep living roots in the soil

5. Integrate livestock

How best can we utilize these practices for California?

Cover Crop Advantages

- Reduce erosion from wind and water.
- Increase soil organic matter content.
- Capture and recycle or redistribute nutrients in the soil profile.
- Promote biological nitrogen fixation and reduce energy use.
- Increase biodiversity.
- Suppress weeds.
- Reduce disease and/or pest pressure.
- Manage soil moisture.
- Minimize and reduce soil compaction.

Soil Management Impacts Soil Health

Columbia fine sandy loam soil type at the Lockeford Plant Materials Center

Tilled soil, note pale coloration and lack of structure	***Improved soil after 5 years no-till and cover crops, note increased structure, roots and darker color.***	***Adjacent walnut orchard, 25 years no-till dark coloration and good structure with numerous pores and roots***

Changes in Management

2010

- Frequent cultivation
- Land left fallow
- Low Soil Organic Matter <1%

By 2019

- NRCS Soil Health Principles
- Diverse cover crop mixes
- Soil Organic matter 2-3%

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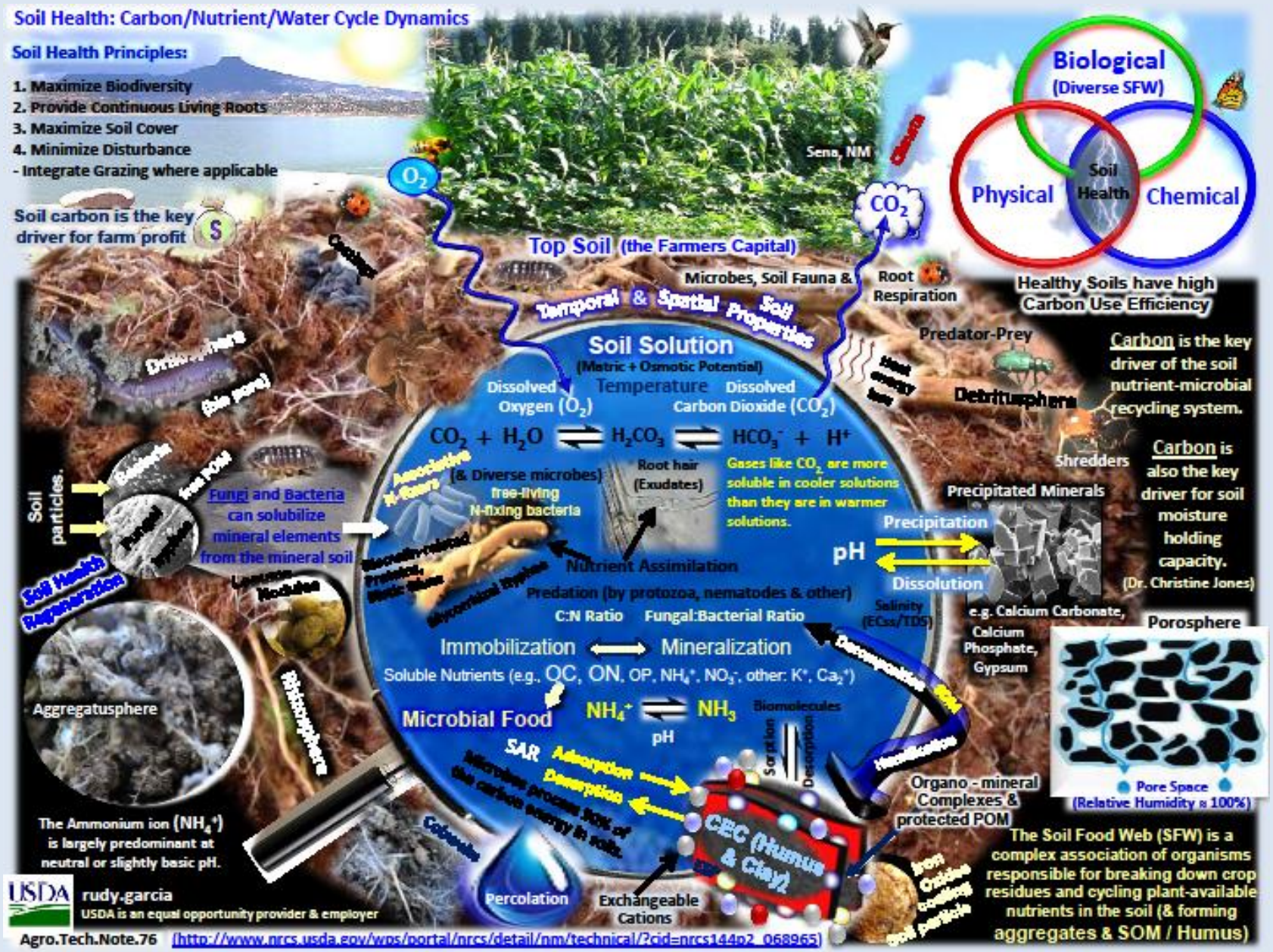

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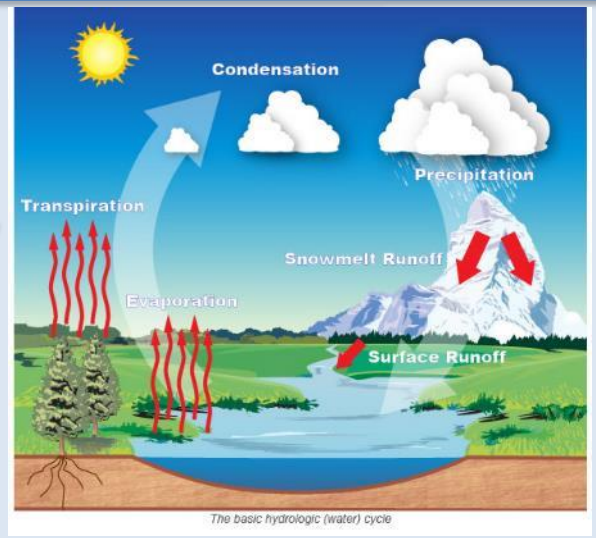
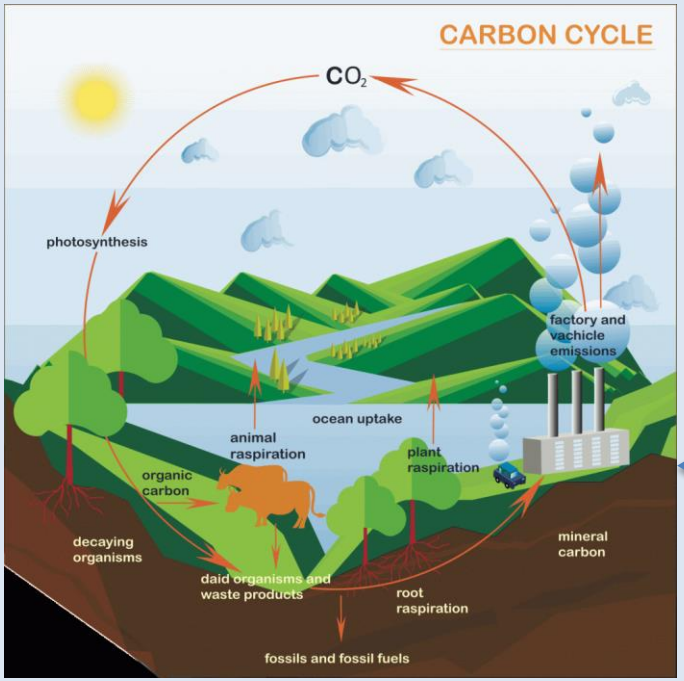
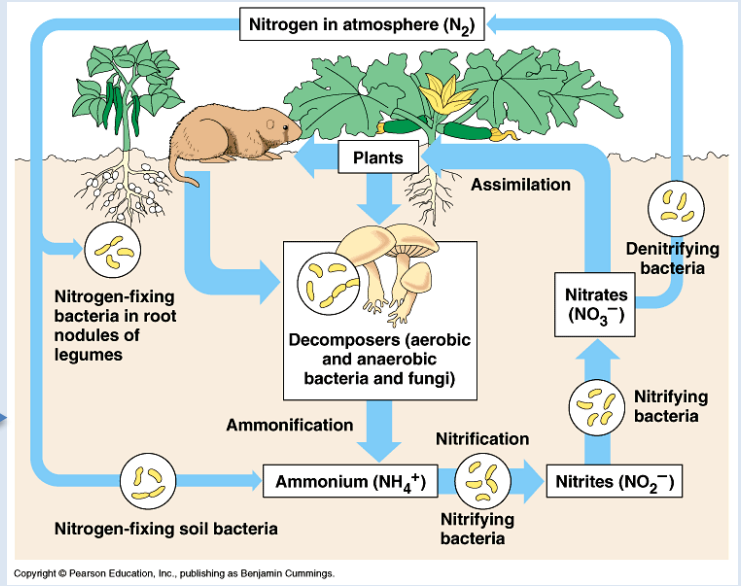
Agro.Tech.Note.76 http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nm/technical/?cid=nrcs144p2_068965

Carbon, Nitrogen and Water Cycles are linked

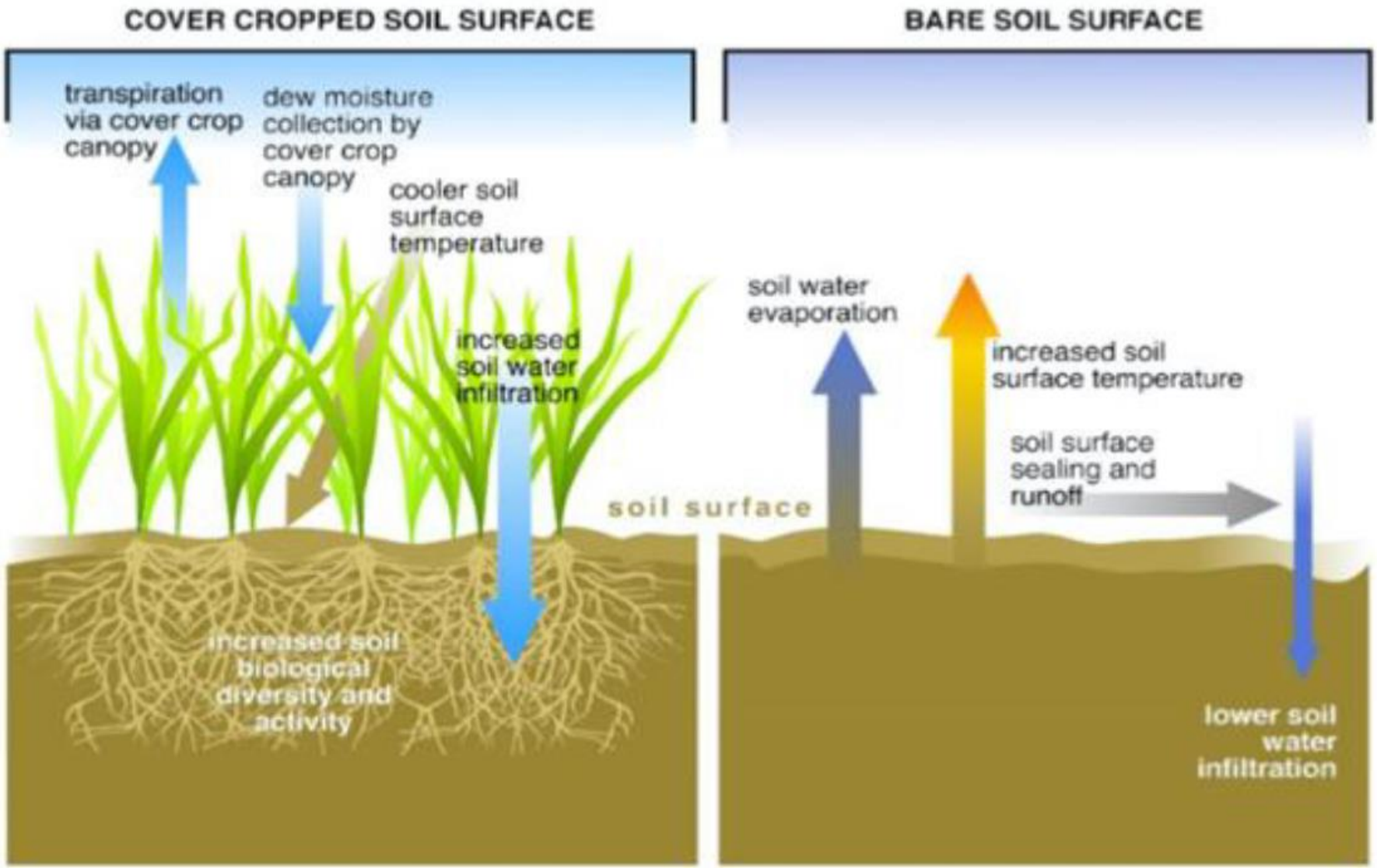




SOIL



Cover crop and water use efficiency



J. Mitchell, A. Gaudin

Cover Crops and Conservation Cover

Cover Crops – Practice 340
Duration: one year

DEFINITION

Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.

PURPOSE

- Reduce erosion from wind and water.
- Increase soil organic matter content.
- Capture and recycle or redistribute nutrients in the soil profile.
- Promote biological nitrogen fixation and reduce energy use.
- Increase biodiversity.
- Suppress Weeds.
- Manage soil moisture.
- Minimize and reduce soil compaction.

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection and or improvement. This practice does not apply to plantings for forage production.

Conservation Cover – Practice 327
Duration: 5 years

DEFINITION

Establishing and maintaining permanent vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce sheet, rill, and wind erosion and sedimentation.
- Reduce ground and surface water quality degradation by nutrients and surface water quality degradation by sediment.
- Reduce emissions of particulate matter (PM), PM precursors, and greenhouse gases.
- Enhance wildlife, pollinator and beneficial organism habitat.
- Improve soil health.

CONDITION WHERE PRACTICE APPLIES

This practice applies on all lands needing permanent herbaceous vegetative cover. This practice does not apply to plantings for forage production or to critical area plantings. This practice can be applied on a portion of the field.

California Cover Crop Selection Chart

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/capmctn13333.pdf

----------Cool Season----------						----------Warm Season----------		
---Grass---								---Grass---
		----------Broadleaf----------						
Annual grasses		----------Legume----------						Corn
Barley	Brassicas	Fava bean						Japanese millet
Cereal Rye	Flax	Field pea	Balansa clover	Red clover	Common vetch	Chickpea	Amaranth	Proso millet
Oats	Phacelia	Lentil	Berseem clover	Rose clover	Hairy vetch	Cowpea	Buckwheat	Sorghum
Triticale	Radish	Lupine	Crimson clover	Sweetclover	Purple vetch	Soybean	Safflower	Sudangrass
Wheat	White mustard	Medic/burr clover	Persian clover	Subterranean clover	Woollypod vetch	Sunnhemp	Sunflower	Teff

Cover Crop Functional Groups

- Monocots
  - Cereals
  - Grasses
- Dicots - Broadleaf
  - Legumes
  - Brassicas
  - Miscellaneous Forbs

Diverse Cover Crop growing near Watsonville, CA. Central Coast April.

Seasonal Choice for Annual Cover Crops

Cool Season

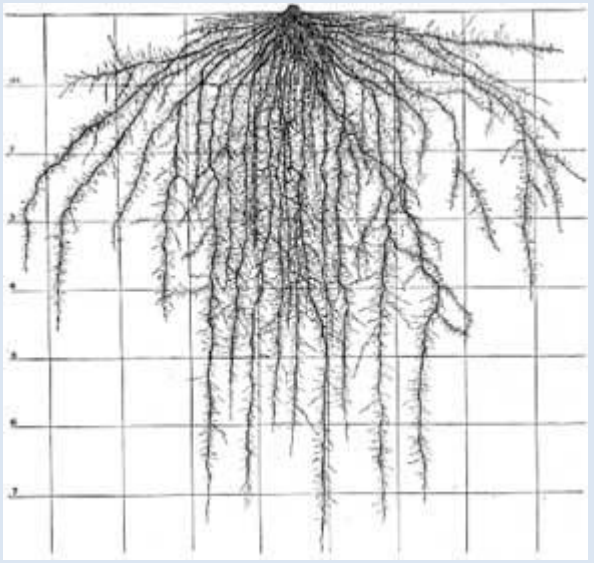
- Planted in fall or early spring.
- Will tolerate cold temperatures and some below freezing temperatures.
- Warm temperatures will cause plants to mature and set seed and die.
- Varying degrees of drought tolerance, depending on species and cultivar.

Warm Season

- Planted in spring after danger of frost has passed, may be planted through the summer to early fall.
- Freezing temperatures will kill these crops (winter kill).
- Tolerate high summer temperatures.
- Varying degrees of drought tolerance, depending on species and cultivar.

Cereals and Grasses

- Fibrous root system
- Good for soil building
- Reduce erosion
- Increase water infiltration
- Increase water holding capacity
- Concentration of nitrogen and phosphorus
- Increase nutrient cycling
- Weed suppression
- Disease suppression
- Root depth will vary with species.



Cereals

Cool Season

Triticale. Other examples; barley, oats, cereal rye, and wheat.

Warm Season

Sudan grass ‘piper’. Other examples sorghum, sudex, Japanese millet, Proso millet.

Annual grasses

Cool Season

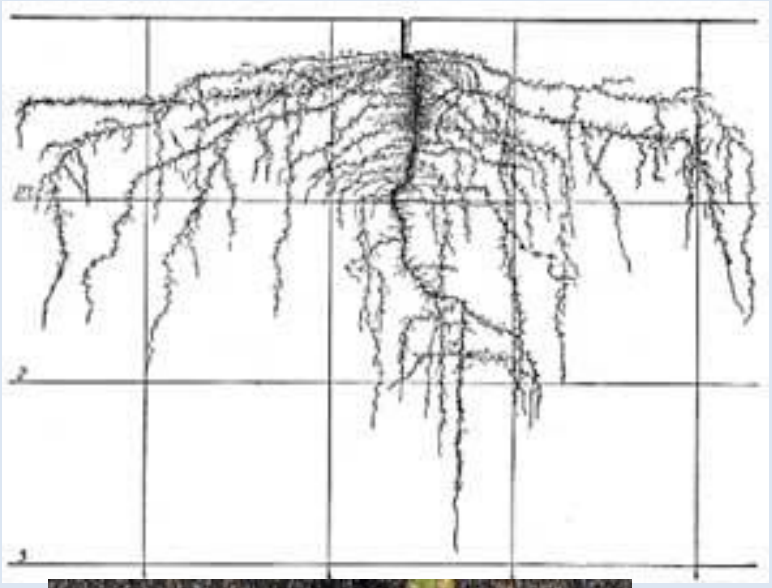
Annual ryegrass.
Other examples, soft chess, annual fescue.

Warm Season

Teff. Other examples?

Legumes - Fabaceae

- Nitrogen Fixation
- Symbiotic Association with Rhizobium Bacteria ‘fix’ nitrogen in root nodules.
- Reduce erosion
- Nutrient cycling
- Water infiltration
- Some species support
  - Pollinators and beneficial insects
  - Pest suppression
  - Weed suppression
- Some species are “hard seeded”, will not all germinate in first year and may persist.
- Caution: Some species may harbor pests and diseases.



Legumes

- Cool Season

Clovers, winter pea, lupine, vetch (common, hairy, woolly pod).

- Warm Season

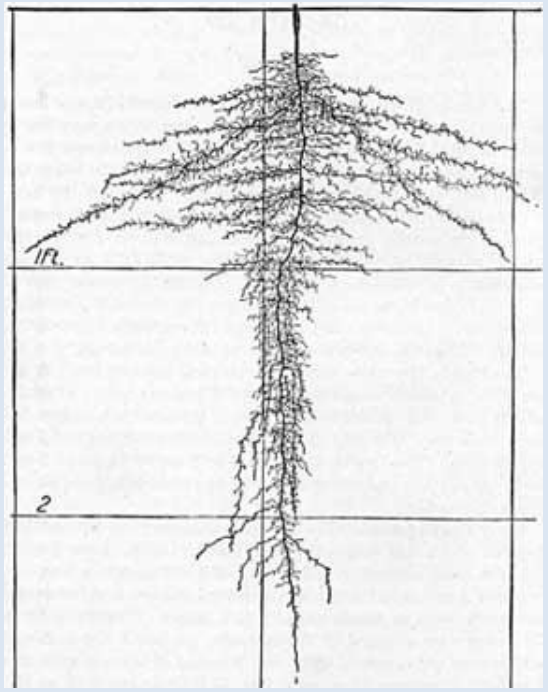
Cowpea, Sunnhemp. Other examples: chickpea, Sesbania, soybean.

Legume Inoculation

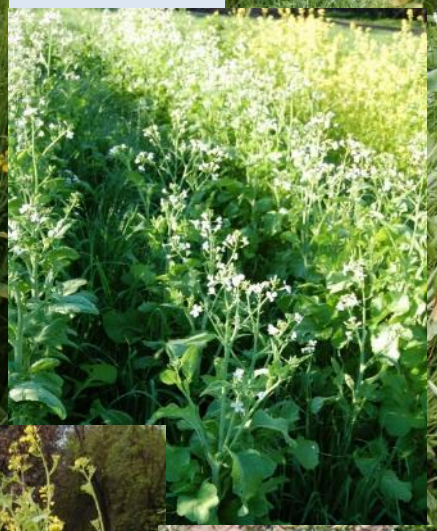
- All legumes should be inoculated with the proper strains of N-fixing bacteria prior to seeding
- Ensures that proper bacteria will be present for nitrogen fixation
- Inoculant should be purchased annually and stored in a cool dry location
- Some legume seed is sold pre-inoculated, so check the label

Brassicaceae

- Strong tap root
- Reduce soil compaction
- Nitrogen scavenger
- Increase infiltration
- Increase water holding capacity
- Some species:
  - Host Pollinators and beneficial insects
  - Pest suppression
  - Weed suppression



Cool Season Brassicas

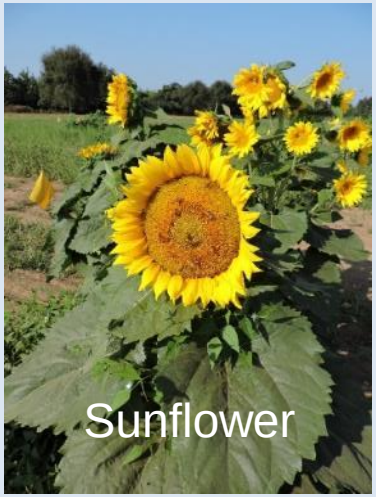


Miscellaneous Pollinators

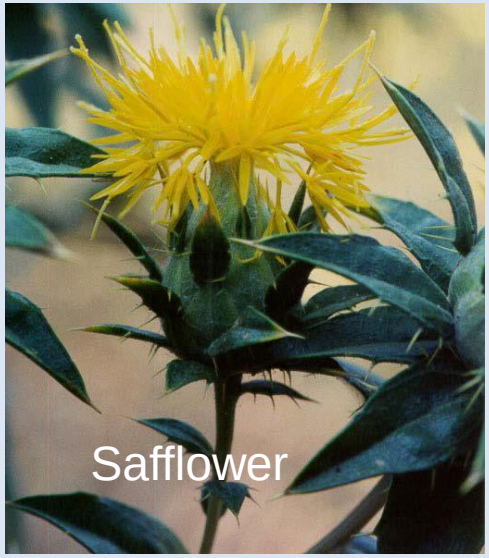

Baby blue eyes


Lacy Phacelia


Batchelors buttons


Sunflower


Great Valley Phacelia


Safflower

Cover Crop Mixtures

- Select species to solve your resource concern problems.
- Purchase ready mixed or design your own.

Conservation Cover: Pollinator Mixes

Perennial Mixes

Xerces pollinator mix for Central Coast and Southern California S&S seeds. Includes a mixture of 10 perennial and annual plants likely to flourish in coastal areas.
Cost now. $62 lb

Re-seeding annuals

Almond mix developed by the Xerces Society and sold by S&S seeds. Includes California poppy, crimson clover and five spot in bloom, a mixture of CA natives and non-native clover.
Cost ?, unavailable right now.

Conservation Cover

- Species selected would depend on resource concerns.
- Discuss avocado and citrus.

Cover Crop Selection

- eVeg Guide: https://www.calflora.org/nrcs/index.html
- SARE: https://www.sare.org/product_search/results/(crop_production)/Cover%20Crops

Considerations

- Understand the cropping system.
- What are the resource concerns?
- When is the Cover Crop “Window”?
- What equipment is available?
  - Planting, Management, Termination.
- Irrigation system and water availability?
- What are the concerns of the producer?
- Cover Crop Selection

Planting for Success

- Good Soil to Seed Contact is essential.
- Consider Seed Size – seed planting depth ~x2 the diameter of the seed.
- Direct drill or Broadcast seeding?
- Use good quality seed from a reputable seed dealer. This will come with a tag and a recent seed test can be requested.
- Plant at recommended seeding rate for species or mix.
- Read seed tag for seed purity and germination. Adjust seeding rate for PLS (pure live seed) if needed.
- Calibrate the seeder!!!!

Seedbed Preparation Direct Drill

Conventional or Clean Tillage

Seed drill planting into a prepared seedbed.

Conservation tillage or no-till

Variety of no-till drills and range drills can be used.

Broadcast Planting

Cultipacker seeder

Seeder/Fertilizer spreader

Belly grinder

Seeding Depth – Seeder must be at the correct depth for planted seeds

Broadcast – harrow to optimize soil to seed contact

Irrigation and water availability

- Will the cover crop be entirely rainfed?
- Irrigation system?
- Is water available to start a cover crop even if there is an irrigation system?
- Drip or microsprinkler in orchards can lead to 2 environments, growth under the trees and desert in the rows.
- How to deal with these scenarios.

Reasons for Seeding Failure

Germination Through Emergence

- Poor quality seed
- Improper timing
- Temperature (too hot!)
- Improper planting depth
- Seed dries out
- Crusted soil surface
- Toxicity
  - allelopathic effects
  - herbicide carryover

After Emergence

- Competition from weeds
- Low fertility
- Poor drainage
- Drought
- Insects
- Improper grazing by livestock
- Foraging by wildlife
- Diseases
- Winterkill

Termination Methods

- Mowing or swathing
  - Chopped material remains as residue on surface, pros and cons for management.
  - Hay or silage production (not compatible with NRCS cover crop practice).
- Roller crimper – widely used in mid-West.
- Disc under (traditional, row crops, organic)
  - Can lead to loss of carbon and soil moisture, and soil structure destroyed .
- Winterkill, warm season only
- Grazing (compatible with NRCS cover crop practice).
- Chemical herbicide

Roller crimper

Timing is critical

- Too early and plants are not terminated and grow back.
- Too late and mature seed is produced.
- Complex viney mixes easiest to terminate

Management Concerns

Problem	Solution
• Frost damage during bloom.	• Select low growing species Mow Cover Crop prior to bloom.
• Weeds in cover crop.	• Select species to compete with weeds, or mow (clovers).
• Water use of cover crops.	• Use drought tolerant cover crops. • Use moisture sensors (IWM) to monitor soil moisture. Time for termination can be optimized so that the crop is mowed down at once water is started to be removed from the soil profile.

Wrap up

- Soil Health Principles
- Cover Crop and Conservation Cover
- Cool and Warm Season Cover Crops
- Cover Crop Mixtures.
- Considerations for selection.
  - Planting methods
  - Irrigation and water availability
  - Termination

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Soil Health Principle 5.
Integrate Livestock
Photo: Amelie Gaudin, UC Davis

Plant Materials Center - Lockeford

Thank you
Any Questions?

Contact Information: Margaret.Smither-Kopperl@usda.gov
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