COVER CROPS

FOR THE SOUTHEAST

Conservation Systems Research

USDA-ARS National Soil Dynamics Laboratory

Auburn University

AUBURN UNIVERSITY

USDA

DIFFERENT COVERS FOR DIFFERENT USES


Brassicas


Buckwheat


Hairy Vetch


White Clover


Wheat

Summer

Winter

Weed control

Nematodes

Compaction

Forage


Rye


Sunn Hemp

Erosion control

Conserve water

Scavenge P&K

Nitrogen


Red Clover


Crimson Clover


Winter Pea


Cowpea


Lupin

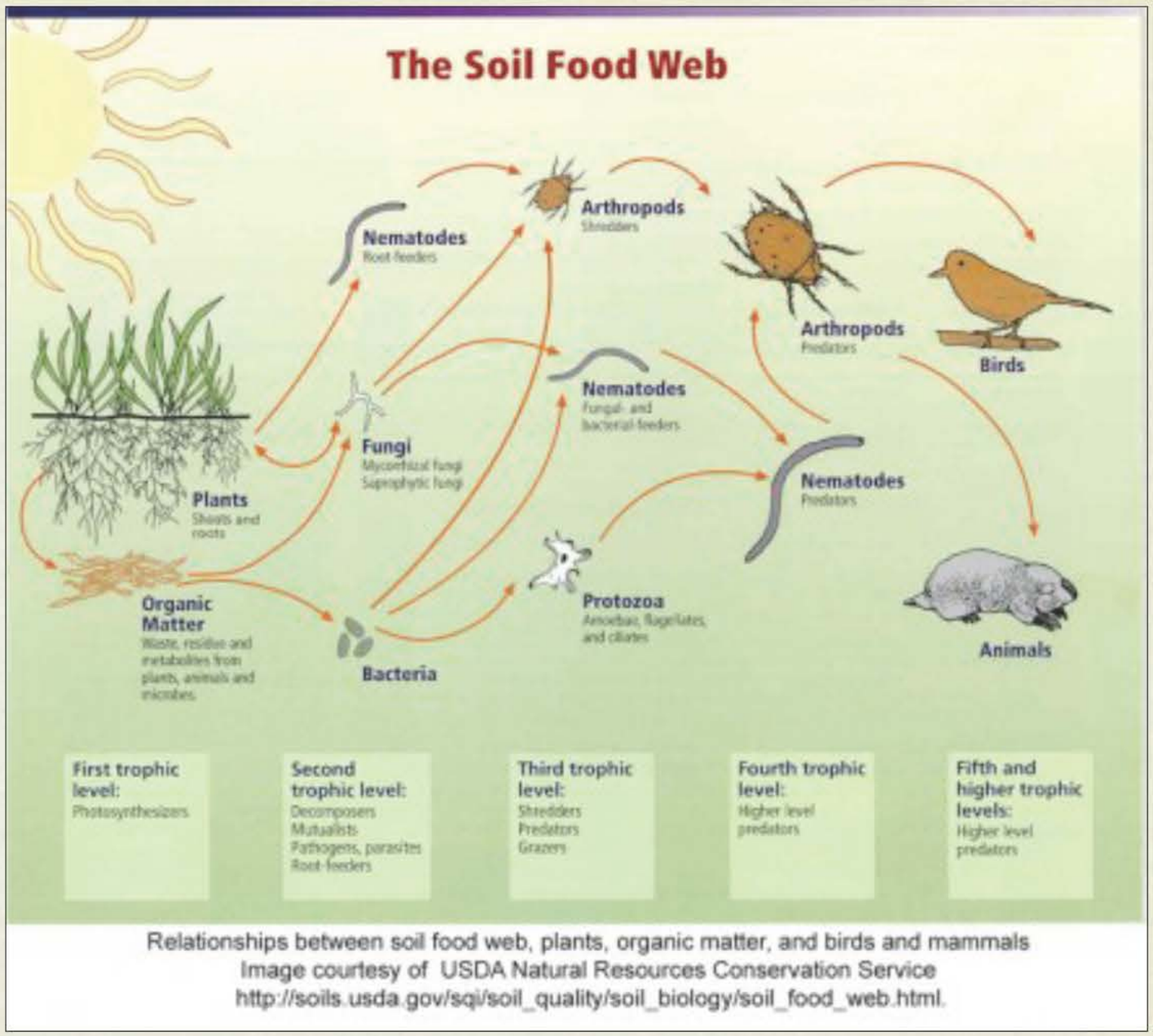
Lots of covers to choose from.
What do you want them to do for you?
When and how long is your window to fit the covers into?

WHY COVER CROPS?

Plants harvest energy from the sun to drive the soil ecosystem.

Bacteria on root tip.

Credit: No. 53 from Soil Microbiology and Biochemistry Slide Set. 1976 J.P. Martin, et al., eds. SSSA, Madison WI.



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html

The soil ecosystem is driven by energy from the sun. Growing plants harvest that energy and convert it to forms that soil organisms can use.
Plant roots exude compounds that other soil organisms can use – sugars, organic acids, amino acids, proteins, …
Plant roots, stems, leaves, etc. are converted (decomposed) by soil organisms into water, carbon dioxide, and organic matter. This organic matter (and the organisms that made it) become food for other organisms.
Photo (bottom left): Bacteria on root tip: Bacteria are abundant around this root tip (the rhizosphere) where they decompose the plentiful simple organic substances. Credit: No. 53 from Soil Microbiology and Biochemistry Slide Set. 1976 J.P. Martin, et al., eds. SSSA, Madison WI.

WHY COVER CROPS?

- Soil Quality
- Soil Fertility
- Reduce Pests
- Other Benefits












Cover crops are important for many reasons. Organic matter is produced by the cover crops. The soil ecosystem uses that organic matter for energy to improve soil quality and fertility. Cover crops also repel pests, attract beneficial organisms, and improve the soil quality in many ways.

WHY COVER CROPS?

- **Soil Quality**
- Soil Fertility
- Reduce Pests
- Other Benefits

- Increase organic matter
- Reduce soil erosion–wind & rain
- Improve soil structure & quality
- Improve soil tilth
- Enhance biological diversity
- Remediate subsoil compaction

Organic matter provides food for soil organisms. It acts as a glue to hold soil particles together into aggregates. Spaces between these aggregates hold soil air and water and provide room for plant roots to grow. Soil microorganisms live in the spaces within aggregates and in the water films that cover all soil particles.

ORGANIC MATTER

- Roots underground break down and add organic matter to the soil.

- Above-ground material decomposes; some moves into the soil.

Black oat

Wheat

Rye

Organic matter drives the soil ecosystem. It feeds soil bacteria, fungi, and animals.
It protects the soil surface.

It is the “glue” that binds soil particles together, strengthening soil structure and improving tilth.

REDUCE COMPACTION

- Cereals produce large amounts of fine roots that improve soil structure and tilth.

- Root exudates and fungi glue soil particles together.

- Crops with long tap roots (tillage radish, sorghum sudangrass) penetrate compacted subsoil.

Rye

Radish

Radish holes

Many cereal plants provide masses of fine roots that add organic matter and reduce compaction.
Root exudates (secretions) are the glue that hold soil particles into aggregates. Fungal filaments (hyphae) also pull soil particles together to create aggregates.
Plants that produce deep tap roots open up the subsoil and create pores for air and water movement and channels that roots of succeeding crops can use.

WHY COVER CROPS?

- Soil Quality
- **Soil Fertility**
- Reduce Pests
- Other Benefits

- Supply nitrogen (legumes)
- Reduce nutrient leaching
- Increase nutrient cycling
- Move nutrients from subsoil to top soil
- Improve fertilizer efficiency

Legume covers produce nitrogen from the air. Free is good!
Other covers scavenge nutrients from the soil that might otherwise leach out. When they die and decompose, the nutrients become available to the following crop.

NITROGEN

Legumes provide nitrogen through bacteria living in root nodules.

Bacterial nodules on soybean root.

Credit: Stephen Temple, New Mexico State University.

White clover

Lupin

Cowpea

Winter pea

Sunn hemp

Hairy vetch

Crimson clover

Photo (middle left): Bacterial nodules on soybean root: Bacteria are abundant around this root tip (the rhizosphere) where they decompose the plentiful simple organic substances. Credit: Stephen Temple, New Mexico State University.

Bacteria living in root nodules take nitrogen from the air and make it available to the plants.
Various legumes grow in summer or winter, in different latitudes, and can be perennials or annuals.

WHY COVER CROPS?

- Soil Quality
- Soil Fertility
- **Reduce Pests**
- Other Benefits
- Suppress weeds
- Reduce diseases
- Reduce nematodes
- Habitat & food for beneficials

Some plants suppress weeds by producing chemicals that inhibit weed growth. Others repel or confuse pests or attract beneficial insects that pollinate crops or kill pests.

PEST CONTROL

- Some covers kill or repel pests.
- Some starve pests.
- Some covers attract predators.

Buckwheat

Cowpea

Winter pea

Soft-winged flower beetle

Predatory wasp

Sunn hemp

Brassicas

Hairy Vetch

Lupin

Lady bird beetle

White clover

Some plants attract beneficial insects that attack pests.
Some plants kill, repel, or confuse pests.

WEED CONTROL

- Heavy surface residue inhibits weed growth.
- Production of allelopathic compounds kills weed seedlings.
- Quick establishment and growth suppresses weeds.

Buckwheat

Cowpea

Brassicas

Black oat

Rye

Rye, black oat, and some other covers leach chemicals that inhibit weed growth.
Covers that produce heavy surface residue block sunlight, reducing weed germination. Surface residue can also physically impede growth of weed seedlings.
Some covers grow and spread quickly, depriving weed seedlings of sunlight, water, and nutrients. These weeds will not produce seeds, so the seed bank will decline.

WHY COVER CROPS?

honey bee

- Soil Quality
- Soil Fertility
- Reduce Pests
- **Other Benefits**
- Reduce labor
- Reduce fuel use
- Reduce land preparation
- Reduce irrigation
- Reduce total production costs
- Improve water quality
- Attract pollinators

honey bee

Covers can reduce labor and fuel by reducing soil prep and weeding operations.
Irrigation trips can be reduced. Surface water flow is slowed or stopped, so soil particles are not carried away.
Fewer trips across the field, fewer irrigation applications means less wear on machinery.
Many attract beneficials, repel pests, provide forage, etc.

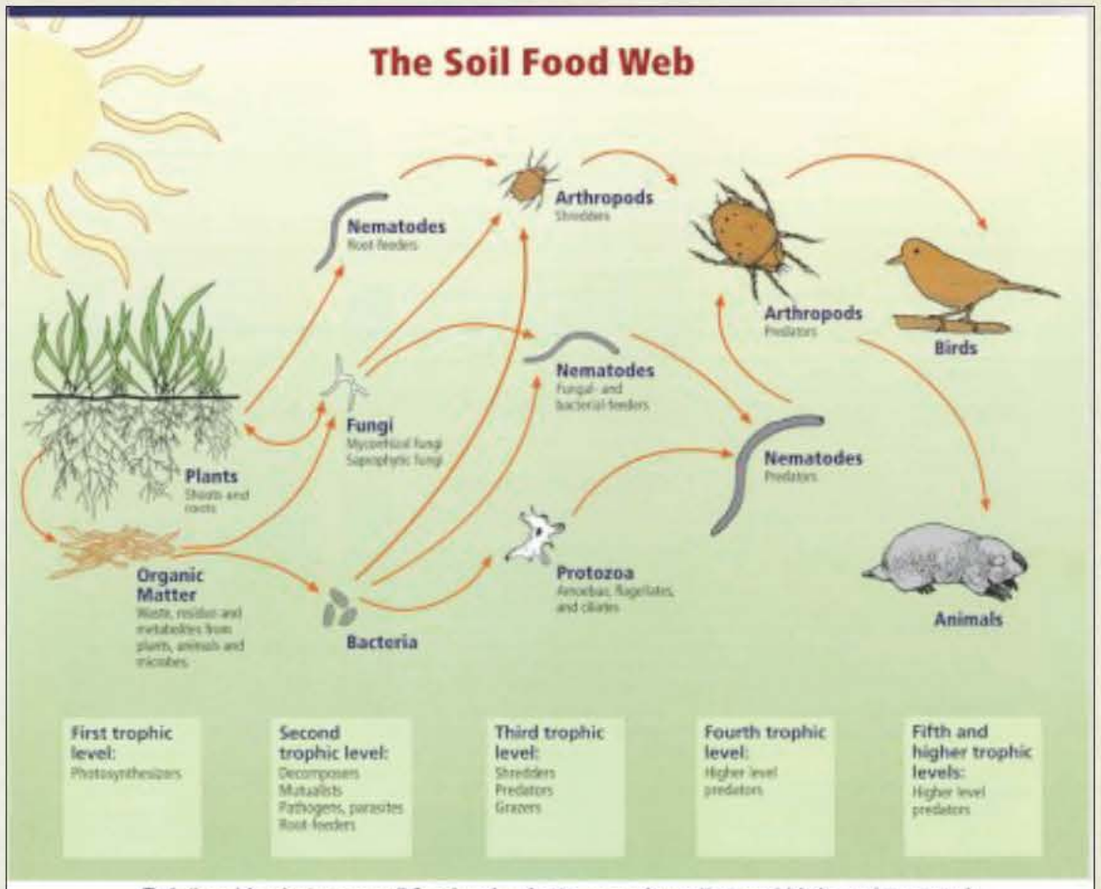
CHALLENGES

- Cost of establishment
- May be difficult to kill
- May compete with your cash crop
- No income from covers
- Requires more management

Money is spent on cover crop seed. Immature covers are sometimes difficult to kill. Covers may deplete soil water if rainfall is deficient. Unless seed or some biomass are sold, there is no income directly from cover crop. Good management is required.

SUMMARY

- Never leave the soil naked.
- ↑ Organic matter ⇒ ↑ Yield.
- Soil doesn't rest – the ecosystem needs food constantly.
- The soil ecosystem is driven by organic matter and root exudates. Cover crops supply these.



Relationships between soil food web, plants, organic matter, and birds and mammals
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http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

Southeastern soils are deficient in organic matter. Never leave the soil bare. Something should always be growing to protect the surface and to feed the soil ecosystem to keep it healthy.

SUMMARY

- Choose a cover for YOUR needs and YOUR system.

Cover Crops

for the Southeast

Uses of Cover Crops

	Compaction Reduction	Residue Persistence	Erosion Control	Weed Control	Nematode Control	Attracts Beneficials	Nitrogen Scavenger	P & K Scavenger	Forage Quality
Legumes									
Austrian Winter Pea	F	F	VG	G	G	VG	F	F	VG
Iron Clay Cowpea	G	F	E	E	G	VG	F	G	G
Crimson Clover	F	G	VG	VG	F	VG	G	G	E
Hairy Vetch	F	F	G	G	F	E	F	G	G
Lupin	G	F	G	G	E	E	F	G	P
Medics	F	G	G	VG	G	F	F	F	VG
Red Clover	VG	F	G	VG	F	VG	G	VG	E
Sunn Hemp	E	G	VG	E	E	F	F	F	P
Velvet Bean	G	G	G	G	E	F	F	F	G
White Clover	F	F	VG	VG	P	G	F	F	E
Cereals									
Barley	FG	E	E	VG	F	G	VG	G	VG
Black Oat	F	G	VG	E	E	P	VG	F	G
Buckwheat	F	P	F	E	F	E	P	E	P
Oat	F	G	VG	E	P	P	VG	F	G
Rye	G	E	E	E	G	F	E	VG	G
Ryegrass	G	VG	VG	VG	G	F	VG	G	VG
Sorghum-Sudangrass	VG	VG	E	VG	VG	G	E	G	VG
Winter Wheat	G	VG	VG	VG	F	F	VG	VG	VG
Other									
Brassicas	G-E	F-G	VG	VG	VG	G	G-E	G	G

E=Excellent; VG=Very Good; G=Good; F=Fair; P=Poor/None


Hairy vetch


Winter Pea


Sunn hemp


Turnip


White Clover

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Conservation Systems Research
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www.ars.usda.gov/msa/auburn/nsdl

Pick the cover crops that suit your needs and your system.

MORE INFORMATION

Books, Web Sites

- Managing Cover Crops Profitably
  http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition

- UC SAREP Cover Crops Database
  http://www.sarep.ucdavis.edu/database/covercrops

- Midwest Cover Crops Council
  http://www.mccc.msu.edu

- Cover Crop Chart – USDA-ARS Northern Great Plains Research Lab
  http://www.ars.usda.gov/Services/docs.htm?docid=20323

Lots of information is available – books, web sites, catalogs, neighbors.

Managing Cover Crops Profitably – www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edtion
UC SAREP Cover Crop Resource Page – www.sarep.ucdavis.edu/ccrop
Midwest Cover Crops Council – www.mccc.msu.edu
Cover Crop Chart – http://www.ars.usda.gov/Services/docs.htm?docid=20323

MORE INFORMATION

Organizations

- Alabama Cooperative Extension System (ACES)
  http://www.aces.edu

- Alabama Fruit & Vegetable Growers Association (AFVGA)
  http://www.aces.edu/dept/associations/afvga

- Alabama Sustainable Agriculture Network (ASAN)
  http://www.asanonline.org

- Sustainable Agriculture Research and Education (SARE)
  http://www.sare.org

- USDA National Soil Dynamics Laboratory
  http://www.ars.usda.gov/msa/auburn/nsdl

Many organizations promote the use of cover crops.

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