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USDA-ARS Northern Great Plains Research Laboratory

Cover Crop Chart

AREA 4 SCD Cooperative Research Farm

GROWTH CYCLE	PLANT ARCHITECTURE	RELATIVE WATER USE
A = Annual	♈ = Upright	💧 = Low
B = Biennial	✱ = Upright-Spreading	💧 = Medium
P = Perennial	≋ = Prostrate	💧 = High

COOL | WARM

GRASS | BROADLEAF | GRASS

A BARLEY ♈								A AMARANTH ♈	A FOXTAIL MILLET ♈
A OAT ♈	A/B CANOLA ✱	A/B CAMELINA ♈	LEGUME					A BUCKWHEAT ♈	A PEARL MILLET ♈
A WHEAT ♈	A/P MUSTARD ✱	A PHACELIA ♈	A FIELD PEA ✱	A BERSEEM CLOVER ♈	A/B VETCH ≋	A SUNNHEMP ♈	A CLUSTER BEAN ♈	A QUINOA ♈	A PROSO MILLET ♈
A CEREAL RYE ♈	A RADISH ✱	A FLAX ♈	A LENTIL ✱	A CRIMSON CLOVER ♈	P BIRDSFOOT TREFOIL ≋	A CHICKPEA ✱	A FAVA BEAN ♈	P CHICORY ✱	A GRAIN SORGHUM ♈
A TRITICALE ♈	B TURNIP ✱	A KALE ✱	A LUPIN ♈	B/P RED CLOVER ♈	A/B SWEET CLOVER ♈	A COWPEA ✱	A MUNG BEAN ✱	A CUCURBITA ≋	A SUDAN GRASS ♈
A ANNUAL FESCUE ♈	B BEET ✱	A SPINACH ✱	A/P MEDIC ✱	P WHITE CLOVER ≋ ♈	P SAINFOIN ♈	A/P FENUGREEK ♈	A SOYBEAN ✱	A SAFFLOWER ♈	A TEFF ♈
P SALINE TOLERANT ♈	A/B CARROT ✱	A/B CHARD ✱	P ROUNDHEAD LESPEDEZA ♈	P KURA CLOVER ≋	P ALFALFA ♈	P PIGEONPEA ✱	A/P PEANUT ✱ ≋	A SUNFLOWER ♈	A CORN ♈

V 2.0. March 2015

◈ *Additional Information*

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Cover Crop Chart

◈ Back to Cover Crop Chart

The Cover Crop Chart is produced and distributed by the staff of the Northern Great Plains Research Laboratory at Mandan, ND.

The Cover Crop Chart represents a compendium of information from multiple sources in the U.S. and Canada. Primary sources of information included the Midwest Cover Crops Council, USDA-SARE, USDA-NRCS PLANTS database, and relevant peer-reviewed journal articles. Designation of warm/cool season crops is based on prevalent growth habits and not photosynthetic pathway. Ranges for seeding depth take into consideration moisture conditions at planting and variation in soil texture. Values for crude protein and C:N ratio assume homogenous samples of aboveground plant material unless stated otherwise. Information on specific crops is occasionally generalized, approximate, and/or incomplete and may not reflect performance in on-farm conditions. USDA-ARS makes no guarantee to the performance of specific crops based on information provided herein. Content and data for crops were assembled by Holly Johnson and Mark Liebig with input from Dave Archer, Heather Dose, Wayne Duckwitz, Marvin Hatzenbuhler, John Hendrickson, Naeem Kalwar, Robert Kolberg, Nancy Jensen, Steve Merrill, Kristine Nichols, Delmer Schlenker, Marty Schmer, Eric Scholljegerdes, Don Tanaka, Cal Thorson, and Dawn Wetch. Chart design by Mark Liebig, Holly Johnson, and Jill Gunderson. The Cover Crop Chart was generated with input from producers and technicians in the Area IV Soil Conservation Districts of North Dakota and NRCS staff at the Bismarck and Dickinson Field/Area Offices.

- Useful cover crop resources:
  - Managing Cover Crops Profitably, 3rd Ed. Andy Clark (Ed.). Handbook Series Book 9, Sustainable Agriculture Network, Beltsville, MD.
  - Midwest Cover Crops Council, www.mccc.msu.edu
  - Sustainable Agriculture Research and Education Program, University of California-Davis, www.sarep.ucdavis.edu
  - USDA-NRCS, PLANTS Database, www.plants.usda.gov

For further information please contact:

Cover Crop Chart
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Crop Sequence Effects

AREA 4 SCD Cooperative Research Farm

CROP RESIDUE	- - - - - - - HIGH RISK CROPS (Crops with the worst performance following a particular residue) - - - - - - -								
Barley	Barley								
Wheat	Wheat								
Canola	Canola	Mustard	Pea	Dry Bean	Flax	Safflower			
Mustard	Soybean	Sunflower							
Flax	Flax								
Pea	Pea	Flax							
Lentil	Lentil								
Chickpea	Buckwheat	Lentil							
Soybean	Canola	Wheat	Barley						
Buckwheat	Chickpea	Sunflower	Grain Sorghum	Sunflower					
Safflower	Safflower	Sunflower	Soybean	Mustard	Dry Bean				
Sunflower	Sunflower	Canola	Pea	Lentil	Buckwheat	Grain Sorghum	Corn	Wheat	Barley
Proso Millet	Proso Millet	Grain Sorghum	Buckwheat						
Grain Sorghum	Grain Sorghum	Proso Millet	Pea	Lenti	Wheat				
Corn	Corn	Wheat	Buckwheat	Grain Sorghum	Proso Millet				

Table adapted from Crop Sequence Calculator (v. 3.1). Software available for download at www.mandan.ars.usda.gov

◈ *Back to Cover Crop Chart*

Barley
(*Hordeum vulgare* L.)

- Cool Season, grass
- Annual
- Upright plant architecture
- Low water use
- Good salinity tolerance
- Seeding depth: ¾ – 2 inches
- Crude protein: hay 10-15%, grain 11-15%
- Benefits from arbuscular mycorrhizal associations
- Self pollinator (wind)
- Rated 'very good' at scavenging nitrogen from the soil

◈ ***View table for known crop sequence effects***

USDA-ARS, NGPRL

Photo by Bob Bugg,
www.sarep.ucdavis.edu/database/covercrops

◈ *Back to Cover Crop Chart*

Cool Season Grass

Oat
(*Avena sativa* L.)

- Cool Season, grass
- Annual
- Upright plant architecture
- Medium water use
- Fair salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: hay 9-15%, grain 13-18%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)
- Rated 'very good' at scavenging nitrogen from the soil

◈ *Back to Cover Crop Chart*

Cool Season Grass

Wheat
(*Triticum aestivum* L.)

- Cool season, grass
- Annual
- Upright plant architecture
- Includes spring and winter wheat varieties
- Medium water use
- Good to fair salinity tolerance
- Seeding depth: ½ – 1 ½ inches
- Crude protein: straw 4-10%, grain 12-16%
- C:N ratio: leaf 15-29, stem 31-65, root 24-74 , straw 80-95 [*end of season*]
- Benefits from arbuscular mycorrhizal associations
- Self pollinator (wind)
- Rated 'very good' at scavenging nitrogen from the soil

◈ ***View table for known crop sequence effects***

USDA-NRCS, PLANTS Database

USDA-ARS, NGPRL

◈ *Back to Cover Crop Chart*

Cool Season Grass

Cereal rye
(*Secale cereale* L.)

- Cool Season, grass
- Annual
- Upright plant architecture
- High water use
- Good salinity tolerance
- Seeding depth: ¼ – 2 inches
- Crude protein: straw 4%, grain 14%
- C:N ratio: 40 – 48
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)
- Rated 'very good' at scavenging nitrogen from the soil

◈ *Back to Cover Crop Chart*

Cool Season Grass

Triticale

(*Triticale hexaploide* Lart.;*Triticosecale rimpaui* Wittm.)

- Cool Season, grass
- Annual
- Upright plant architecture
- Fall and spring types available
- High water use
- Good salinity tolerance
- Seeding depth: 1 ½ – 2 inches
- Crude protein: hay 9-16%, grain 17%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

Photo by Ken Miller
Burleigh County Soil Conservation District

Photo by Matt Liebman, Iowa State University www.mccc.msu.edu

◈ *Back to Cover Crop Chart*

Cool Season Grass

Annual fescue
(*Vulpia myuros* L.; *Fetuca* sp.)

- Cool Season, grass
- Annual
- Upright plant architecture
- Alternate names: Rattail fescue, Foxtail fescue
- Low water use
- Poor salinity tolerance
- Seeding depth: ¼ – 1 inch
- Crude protein: hay 8-10%
- Benefits from arbuscular mycorrhizal associations

◈ *Back to Cover Crop Chart*

Cool Season Grass

Saline Tolerant Grasses

- Cool Season, grass
- Perennial
- Upright plant architecture
- Low to moderate water use
- Moderate to high salinity tolerance
- Seeding depth: ¼ – 1 inch
- Crude Protein: 7 – 19%
- Forms arbuscular mycorrhizal associations
- Many species are available in this category; each varies slightly in plant characteristics

- *See the next six slides for more detail*

◈ *Back to Cover Crop Chart*

RS Hybrid Wheatgrass
(*Elymus hoffmannii* K.B. Jensen & K.H. Asay)

- Cool season, grass
- Perennial
- Upright plant architecture
- Alternate name: Green wheatgrass
- Low water use
- Moderate to high salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: 7 – 12%
- RS hybrid wheatgrass is a hybrid between quackgrass (*Elymus repens*) and bluebunch wheatgrass (*Pseudoroegneria spicata*)

No Photo Available

◈ *Back to Cover Crop Chart*

Saline Tolerant

Cool Season Grass

Tall Wheatgrass
(*Thinopyrum ponticum* (Podp.))

- Cool season, grass
- Perennial (introduced)
- Upright plant architecture
- Alternate name: Rush wheatgrass
- Moderate water use
- Excellent salinity tolerance
- Seeding depth: ¼ – 1 inch
  *shallower for finer textured soils
- Crude protein: 7 – 19%
  - vegetative >10%
  - late bloom 6%
  - fully mature 2-3%

◈ *Back to Cover Crop Chart*

Saline Tolerant

Cool Season Grass

Intermediate Wheatgrass

(*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey)

- Cool season, grass
- Perennial (introduced)
- Upright plant architecture
- Alternate name: Pubescent wheatgrass
- Low to moderate water use; drought tolerant
- Good salinity tolerance
- Seeding depth: ½ – 1 inch
- Crude protein: 8 – 17%*
  *Northern Plains: may fall below 4% at the end of the season
- Cross-pollinates.
- Spreads vegetatively; under ideal conditions, it can slowly spread into adjacent communities
- Persistence of stand is limited (typically < 5 yr)

Saline Tolerant

Cool Season Grass

◈ *Back to Cover Crop Chart*

Slender Wheatgrass
(*Elymus trachycaulus* (Link) Gould ex Shinners)

- Cool season, grass
- Perennial, short-lived (native)
- Upright plant architecture
- Low water use; will not tolerate water-logged soils
- Good salinity tolerance
- Seeding depth: ¼ – ¾ inch
- Crude protein: 22 – 25% (Spring); less than 10% (fall)
- May form arbuscular mycorrhizal associations

◈ *Back to Cover Crop Chart*

Saline Tolerant

Cool Season Grass

Russian Wildrye
(*Psathyrostachys junceus* (Fisch.) Nevski)

- Cool season, grass
- Perennial (introduced)
- Upright plant architecture
- Low water use
  - drought tolerant
  - does not tolerate flooding
- Good salinity tolerance
- Seeding depth: ¼ – ½ inch
  - Sensitive to seeding depth – too deep will inhibit seed germination
- Crude protein: 5 – 17 %
- Difficult to establish

◈ *Back to Cover Crop Chart*

Saline Tolerant

Cool Season Grass

Alkaligrass
(*Puccinellia sp.* Parl.)

- Cool season, grass
- Perennial
- Upright plant architecture
- Nuttall's alkaligrass, *Puccinellia nuttalliana* [Schult.] Hitch.
  - Native to semi-arid, North American zones
- Weeping alkaligrass, *Puccinellia distans* [Jacq.] Parl.
  - Introduced [Eurasia]
  - Highest salinity tolerance of this genus
- Low to moderate water use
  - Can survive arid areas as well as marsh, basin, or wetland zones
- Excellent salinity tolerance
- Seeding depth: ¼ - ½ inch

- *This slide completes the review of saline tolerant grasses*

◈ *Back to Cover Crop Chart*

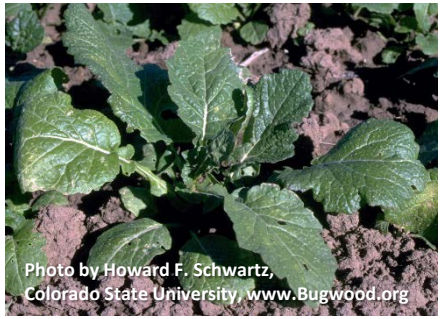
Saline Tolerant

Cool Season Grass

Canola
(*Brassica napus*)

- Cool Season, broadleaf
- Major types:
  - Annual (spring-type)
  - Biennial (winter-type)
- Upright and spreading plant architecture
- Alternate name: Rapeseed
- Medium water use
- Good salinity tolerance
- Seeding depth: ¼ – 1 inch
- Crude protein: hay 16%, grain 21%, silage 12%, pasture 17%
- C:N ratio: leaf 12-16, stem 21-37, root 24-43
- Does not form arbuscular mycorrhizal associations
- Rated 'very good' at scavenging nitrogen from the soil
- Flowers attract pollinator

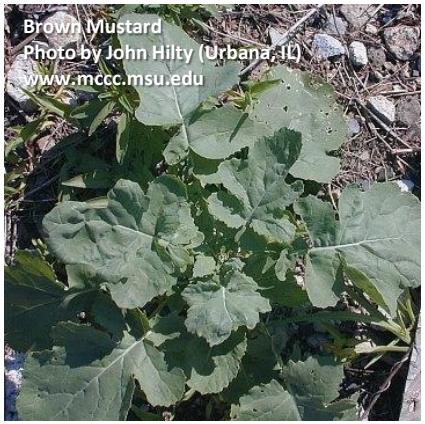
◈ *View table for known crop sequence effects*



◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Mustard
(*Brassica sp.* L.)



- Cool Season, broadleaf
- Annual or perennial
- Upright and spreading plant architecture
- Major types: Indian, Oriental, brown, yellow
- Related to crambe
- Low water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: hay 10%, grain 24-35%
- C:N ratio: 10 – 30
- Does not form arbuscular mycorrhizal associations
- Rated 'good' at scavenging nitrogen from the soil
- Plants from the *Brassica* group have potential to release compounds or metabolic by-products that work as bio-toxins against bacteria, fungi, insects, nematodes, and weeds
- Flowers may attract pollinators

◈ *View table for known crop sequence effects*

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Radish
(*Raphanus sativus*)

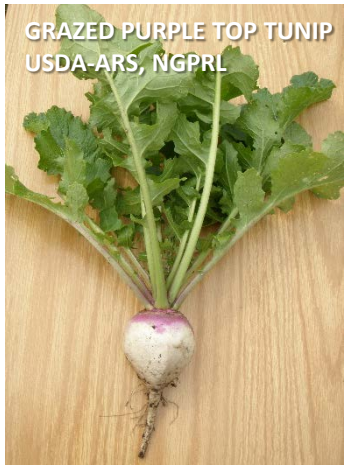
- Cool Season, broadleaf
- Annual
- Upright and spreading plant architecture
- Root crop
- Major types:
  - Oilseed (var. *oleiformis*)
  - Forage (var. *niger*): Daikon
- High water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: 26-30%
- C:N ratio: oilseed 19 – 20
- Does not form arbuscular mycorrhizal associations
- Rated 'very good' at scavenging nitrogen from the soil
- Flowers attract pollinators

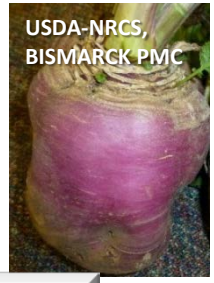
◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Turnip
(*Brassica rapa* L. var. *rapa*)

- Cool Season, broadleaf
- Biennial
- Upright and spreading plant architecture
- Root crop
- High water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: tops 16%, root 12-14%
- Closely related to rutabaga
- Does not form arbuscular mycorrhizal associations
- Rated 'good' at scavenging nitrogen from the soil
- Flowers attract pollinators





◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Beet
(*Beta vulgaris*)

- Cool Season, broadleaf
- Biennial
- Upright and spreading plant architecture
- Root crop
- High water use
- Variable salinity tolerance, depending on beet type
- Seeding depth: ½ - ¾ inch
- Crude protein: tops 12-15%, root 7-10%
- C:N ratio: tops 11 – 14
- Does not form arbuscular mycorrhizal associations
- Rated 'good' at scavenging nitrogen from the soil
- Self pollinator (wind)
- Multiple sub-species including garden beets and sugar beets

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Carrot
(*Daucus carota* var. *sativus* L.)

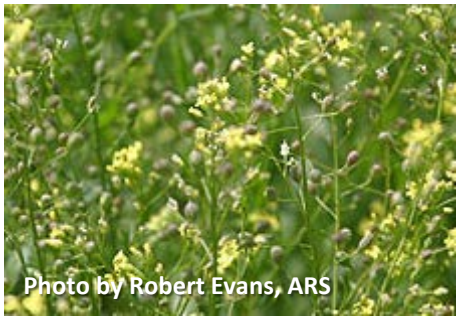
- Cool Season, broadleaf
- Major types:
  - Biennial (cultivated)
  - Annual (wild)
- Upright and spreading plant architecture
- Root crop
- High water use
- Seeding depth: ⅛ - ¼ inch
- Crude protein: 10%
- Forms arbuscular mycorrhizal associations
- Plants may bolt and flower starting in second year of growth
- Flowers may attract pollinators

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Camelina
(*Camelina sativa* (L.) Crantz)

- Cool Season, broadleaf
- Annual, biennial
- Upright plant architecture
- Alternate names: False flax, Gold-of-pleasure
- Low water use
- Fair salinity tolerance
- Seeding depth: ⅛ – ¼ inch
- Crude Protein: 46%
- C:N Ratio: stems 40-95; pods 25-70; seed 12-16
- Does not form arbuscular mycorrhizal associations
- Mainly a self pollinator but benefits from exposure to high population of pollinators
- Sensitive to imidazolinone and sulfentrazone herbicides



◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Phacelia
(*Phacelia tanacetifolia* Benth.)

- Cool Season, broadleaf
- Annual
- Upright plant architecture
- Low water use
- Low salinity tolerance
- Seeding depth: ⅛ – ¼ inch
- C:N ratio: 10 – 15
- Forms arbuscular mycorrhizal associations
- Attracts beneficial insects

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Flax
(*Linum usitatissimum* L.)

- Cool Season, broadleaf
- Annual
- Upright plant architecture
- Medium water use
- Fair salinity tolerance
- Seeding depth: ½ – 1 ½ inch
- Benefits from arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Kale
(*Brassica napus* L. var. *pabularia*)

- Cool Season, broadleaf
- Annual
- Upright and spreading plant architecture
- Major types:
  - Siberian
  - Russian
- Medium water use
- Fair salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: ≈30%
- C:N ratio: 10 – 30
- Does not form arbuscular mycorrhizal associations

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Spinach
(*Spinacia oleracea* L.)

- Cool Season, broadleaf
- Annual
- Upright and spreading plant architecture
- Low to medium water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: ≈20%
- C:N ratio: 6 – 8
- Sensitive to acid soils
- Does not form arbuscular mycorrhizal associations

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Chard
(*Beta vulgaris* L. ssp. *cicla* (L.) W.D.J. Koch)

- Cool season, broadleaf
- Annual, Biennial
- Upright spreading plant architecture
- Alternate names: Swiss chard, silverbeet, perpetual spinach, spinach beet, crab beet, bright lights, seakale beet, and mangold
- High water use
- Poor salinity tolerance
- Seeding depth: ½ - 1 inch
- Crude Protein: 32%
- Does not form arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ *Back to Cover Crop Chart*

Cool Season Broadleaf

Field pea
(*Pisum satuvum arvense* L.)

- Cool Season, broadleaf
- Annual
- Legume (N fixation)
- Upright plant architecture (vine)
- Low water use
- Poor salinity tolerance
- Seeding depth: 1 – 3 inches
- Crude protein: hay 14%, grain 24%, silage 15%
- C:N ratio: leaf 13-25, stem 27-83, root 17-27
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Cool Season Legume

Lentil
(*Lens culinaris* Medik.)

- Cool Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture
- Low water use
- Poor salinity tolerance
- Seeding depth: 1 – 1 ½ inch
- Crude protein: hay 14%, grain 28%, silage 15%
- C:N ratio: leaf 11-21, stem 25-49, root 22-30
- Forms arbuscular mycorrhizal associations
- Self-pollinated but flowers may attract pollinators

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Cool Season Legume

Lupin
(*Lupinus sp*. L.)

- Cool Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright plant architecture
- Examples include blue, narrow-leaved, European yellow, white, Spanish, etc.
- Low water use
- Prefers acid soils
- Seeding depth: 1 – 2 inches
- Crude protein: silage 15%
- C:N ratio: leaf 12-30, stem 25-49
- Does not form arbuscular mycorrhizal associations
- Flowers attract pollinators

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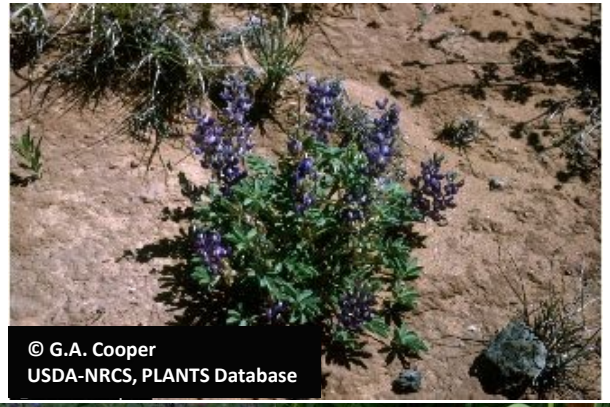
USDA-NRCS, PLANTS Database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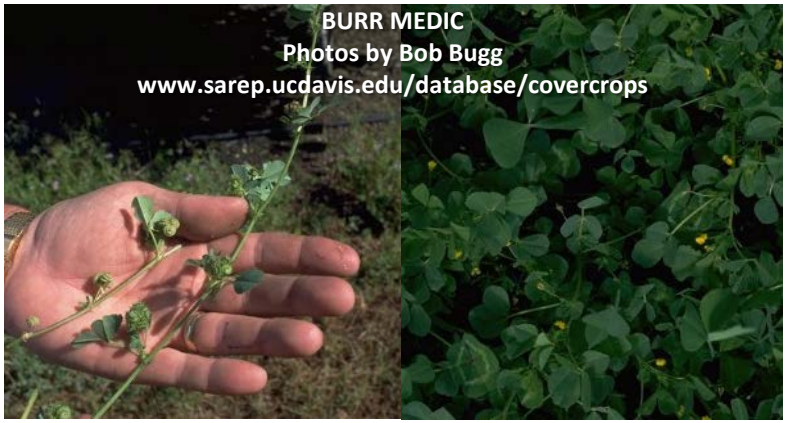
Photos by Bob Bugg
www.sarep.ucdavis.edu/database/covercrops

◈ *Back to Cover Crop Chart*

Cool Season Legume

Medic
(*Medicago* spp.)

- Cool Season, broadleaf
- Annual or perennial
- Legume (N-fixation)
- Upright and spreading plant architecture
- Over 35 known medic species exist. Common examples include barrel, black, & burr.
- Low water use
- Poor to fair salinity tolerance
- Seeding depth: ¼ inch
- Crude protein: black medic 19-21%
- Forms arbuscular mycorrhizal associations
- Attracts pollinators



◈ *Back to Cover Crop Chart*

Cool Season Legume

Roundhead Lespedeza
(*Lespedeza capitata* (Michx.))

- Cool Season, broadleaf
- Perennial
- Legume (N-fixation)
- Upright plant architecture
- Alternate names: Roundhead bush clover, bushclover, rabbit foot
- Low salinity tolerance
- Seeding depth: ¼ - ½ inch
- C:N ratio: ≈ 23
- Crude Protein: 11%
- Forms arbuscular mycorrhizal associations

◈ *Back to Cover Crop Chart*

Cool Season Legume

Berseem Clover
(*Trifolium alexandrinum* L.)

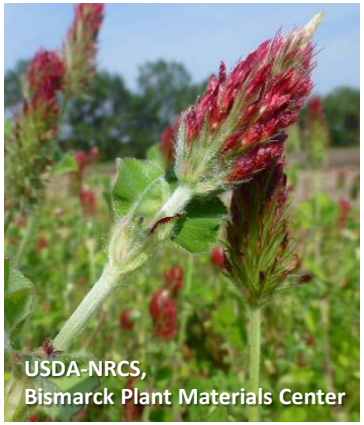
- Cool Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright plant architecture
- Alternate name: Egyptian clover
- Low water use
- Fair salinity tolerance
- Seeding depth: ¼ – 1 inch
- Crude protein: 27-29%
- C:N ratio: 18 – 23
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ *Back to Cover Crop Chart*

Cool Season Legume

Crimson Clover
(*Trifolium incarnatum* L.)

- Cool season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture
- Medium water use
- Poor salinity tolerance
- Seeding depth: ¼ - ½ inch
- Crude protein: 18%
- C:N ratio: 16 - 19
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators



◈ *Back to Cover Crop Chart*

Cool Season Legume

Red Clover
(*Trifolium pratense* L.)

- Cool Season, broadleaf
- Biennial; short-lived perennial
- Legume (N-fixation)
- Upright plant architecture
- Two types:
  - medium, perennial or biennial; (2-3 cuts per season)
  - mammoth (1 cut per season)
- Medium water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: 15%
- C:N ratio: 15 – 23
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ *Back to Cover Crop Chart*

Cool Season Legume

White Clover
(*Trifolium repens* L.)

- Cool Season, broadleaf
- Perennial
- Legume (N-fixation)
- Upright and spreading or prostrate plant architecture
- 3 Types grouped by size:
  1. <u>Large</u>: tallest of the white clovers, upright architecture, high forage quality but less durable [var. Ladino]
  2. <u>Intermediate</u>: most common white clover, flowers earlier, and has a higher heat tolerance, upright architecture [var. Dutch white, New Zealand White]
  3. <u>Small</u>: lowest growing type, prostrate; survives grazing [var. Wild White]
- Medium water use
- Poor salinity tolerance
- Seeding depth: ¼ inch
- Crude protein: 24 – 30%
- C:N ratio: 13 – 23
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators
- Aggressive growth in some regions or habitats; may displace desirable vegetation if not properly managed

◈ *Back to Cover Crop Chart*

Cool Season Legume

Kura Clover
(*Trifolium ambiguum* M. Bieb.)

- Cool season, broadleaf
- Perennial
- Legume (N-fixation)
- Prostrate plant architecture
- Also called Caucasian, honey, and pellet clover
- Moderate water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: 23 – 25%
- Forms arbuscular mycorrhizal association
- Flowers attract pollinators

◈ *Back to Cover Crop Chart*

Cool Season Legume

Vetch
(*Vicia sp.*)

- Cool Season, broadleaf
- Annual or biennial
- Legume (N-fixation)
- Prostrate plant architecture (vine)
- Common examples include hairy, purple, and smooth vetch
- Low to medium water use
- Poor salinity tolerance
- Seeding depth: 1 ½ – 2 ½ inches
- Crude protein: 13-20%
- C:N ratio: 10 – 19
- Forms arbuscular mycorrhizal associations
- Attracts pollinators

Hairy Vetch

Chickling Vetch

◈ *Back to Cover Crop Chart*

Cool Season Legume

Birdsfoot trefoil
(*Lotus corniculatus* L.)

- Cool Season, broadleaf
- Perennial, short lived
- Legume (N-fixation)
- Prostrate plant architecture
- Low to medium water use
- Fair salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: hay 16 - 22%
- Forms arbuscular mycorrhizal associations
- Attracts pollinators

Photo by Bob Bugg
www.sarep.ucdavis.edu/database/covercrops

Photo by Robert H. Molenbrock
USDA-NRCS, PLANTS database

Photo by Jim Stasz
USDA-NRCS, PLANTS database

www.sarep.ucdavis.edu/database/covercrops

◈ *Back to Cover Crop Chart*

Cool Season Legume

Sweetclover
(*Melilotus sp.* L)

- Cool Season, broadleaf
- Annual or biennial
- Legume (N-fixation)
- Two types
  - yellow *Melilotus officinalis* L.
  - white *Melilotus alba* L.
- Upright plant architecture
- Moderate water use
- Fair salinity tolerance
- Seeding depth: ½ inch
- Crude protein: 11-18%
- C:N ratio: 12 – 23
- Forms arbuscular mycorrhizal associations
- Attracts pollinators

WHITE TYPE

YELLOW TYPE

◈ *Back to Cover Crop Chart*

Cool Season Legume

Sainfoin
(*Onobrychis viciifolia* Scop.)

- Cool Season, broadleaf
- Perennial
- Legume (N-fixation)
- Upright plant architecture
- Medium to high water use
- Fair to poor salinity tolerance
- Seeding depth: ¼ – ¾ inch
- Crude protein: 13-20%
- Forms arbuscular mycorrhizal associations
- Attracts pollinators

◈ *Back to Cover Crop Chart*

Cool Season Legume

Alfalfa
(*Medicago sativa* L.)

- Cool Season, broadleaf
- Perennial
- Legume (N-fixation)
- Upright plant architecture
- High water use
- Poor salinity tolerance
- Seeding depth: ¼ – ½ inch
- Crude protein: 14-22%
- C:N ratio: 11 – 13
- Non-dormant cultivars can perform like an annual
- Forms arbuscular mycorrhizal associations
- Good at scavenging nitrogen from the soil
- Attracts pollinators

◈ *Back to Cover Crop Chart*

Cool Season Legume

Sunnhemp
(*Crotalaria juncea* L.)

- Warm season, broadleaf
- Annual
- Legume (N-fixation)
- Upright plant architecture
- Low to moderate water use
- Poor salinity tolerance
- Seeding depth: ½" – 2 ½" inches
- 'Good' N-fixation capacity
- Forms arbuscular mycorrhizal associations
- Self pollinates (wind) as well as cross-pollinates (insects/birds)
- Rated 'Excellent' at controlling soil nematodes
- Used as a green manure, forage*, or fiber crop
- Certain cultivars contain alkaloids which are poisonous to livestock; check before feeding to animals

'Tropic Sun' Sunn hemp
Georgia Plant Materials Program

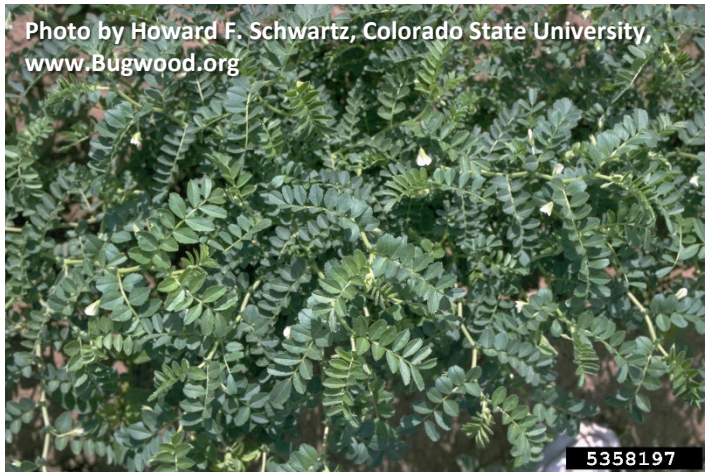
◈ *Back to Cover Crop Chart*

Warm Season Legume

Chickpea
(*Cicer arietinum* L.)

- Warm Season, broadleaf
- Annual
- Legume (N-fixation)
- Two types
  - Desi
  - Kabuli
- Upright and spreading plant architecture
- Alternate name: garbanzo bean
- Low water use
- Poor salinity tolerance
- Seeding depth: 1 ½ – 2 inches
- Crude protein: straw 6%, grain 22%
- C:N ratio: leaf 10-15, stem 26-56, root 16-27
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ *View table for known crop sequence effects*



◈ *Back to Cover Crop Chart*

Warm Season Legume

Cowpea
(*Vigna unguiculata* L.)

- Warm Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture (vine)
- Alternate names: Southern pea, black-eye pea
- Low water use
- Fair salinity tolerance
- Seeding depth: ¾ – 1 inch
- Crude protein:
  - grain and leaves 19-30%
  - stems 13-17%
- C:N ratio: 18 – 22
- Forms arbuscular mycorrhizal associations
- Attracts pollinators

◈ *Back to Cover Crop Chart*

Warm Season Legume

Fenugreek
(*Trigonella sp.* L.)

- Warm Season, broadleaf
- Annual/Perennial
- Legume (N-fixation)
- Two types:
  - cultivated [*T. corniculata*];
  - forage or sickle fruit [*T. foenum-graecum*]
- Upright plant architecture
- Alternate name: Greek hay
- Low water use
- Poor salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: 16 – 25%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)
- Used as a forage, spice, and for health benefits*

  *contains nutraceuticals:

  1. steroidal sapogenin
  2. galactomannan
  3. isoleucine

◈ *Back to Cover Crop Chart*

Warm Season Legume

Pigeonpea
(*Cajanus cajan* (L.) Millsp.)

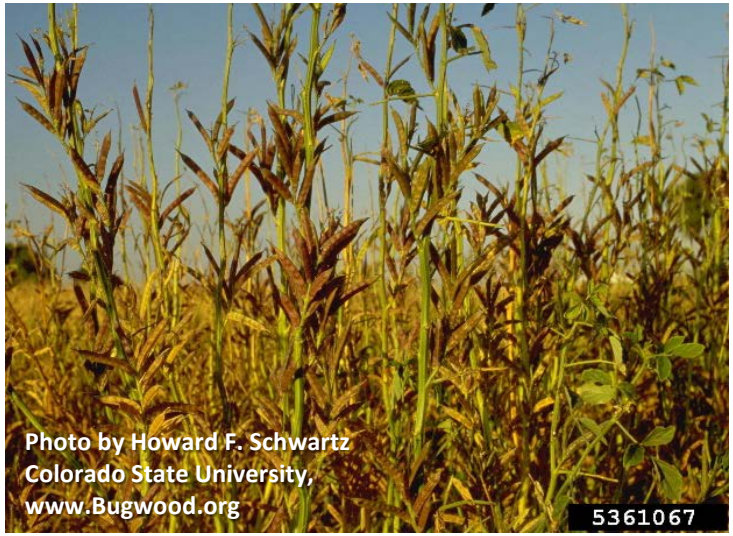
- Warm season, broadleaf
- Perennial
- Legume (N-fixation)
- Upright and spreading plant architecture
- Alternate names: Angola pea, Congo pea, dhal, no-eye pea, gungo pea, and red gram
- Low water use
- Moderate to high salinity tolerance
- Seeding depth: 1 ½ inch
- Crude protein: 28-36%
- C:N ratio: 20
- Forms arbuscular mycorrhizal associations
- Mostly self-pollinated

◈ *Back to Cover Crop Chart*

Warm Season Legume

Cluster bean
(*Cyamopsis tetragonoloba* L. Taub)

- Warm Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture
- Alternate names: Guar, guar bean, c
- Low water use
- Good salinity tolerance
- Seeding depth: 1 – 1 ½ inch
- Crude protein:
  - Straw 7 – 10%
- C:N ratio: 65 (residue)
- Forms arbuscular mycorrhizal associations
- Self-pollinated
- Can be used as a green manure or forage
- Plant extract (gum) has industrial uses



◈ *Back to Cover Crop Chart*

Warm Season Legume

Fava Bean
(*Vicia faba* L.)

- Warm season, broadleaf
- Annual
- Legume (N-fixation)
- Upright plant architecture (vine)
- Alternate names: Bell bean, horse bean
- Medium water use; poor drought tolerance
- Moderate salinity tolerance (depending on variety)
- Seeding depth: 2-4 inches
- Crude protein: 17%
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ *Back to Cover Crop Chart*

Warm Season Legume

Mung bean
(*Vigna radiata* L.)

- Warm Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture
- Low to medium water use
- Poor salinity tolerance
- Seeding depth: 1 ½ – 3 inches
- Crude protein: 16-23%
- C:N ratio: 10 – 15
- Forms arbuscular mycorrhizal associations
- Self-pollinated

◈ *Back to Cover Crop Chart*

Warm Season Legume

Soybean
(*Glycine max* (L.) Merr.)

- Warm Season, broadleaf
- Annual
- Legume (N-fixation)
- Upright and spreading plant architecture
- Medium water use
- Poor salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: hay 17%, grain 42%
- C:N ratio: leaf 14, stem 39, root 34
- Forms arbuscular mycorrhizal associations
- Self-pollinated but flowers may attract pollinators

◈ ***View table for known crop sequence effects***

USDA-NRCS,
Bismarck Plant Materials Center

Photo by Todd Martin (MSU-KBS), www.mccc.msu.edu

◈ *Back to Cover Crop Chart*

Warm Season Legume

Peanut

(Annual - *Arachis hypogaea* L.; Perennial – *Arachis glabrata* L.)

- Warm season, broadleaf
- Annual, Perennial
- Legume (N-fixation)
- Upright and spreading (annual) or prostrate (perennial) plant architecture
- Alternate name: Groundnut
- High water use
- Poor salinity tolerance
- Seeding depth: 1 – 4 inches

  **Perennial peanuts are planted using rhizomes only*
- Crude Protein: 13 – 20%
- Forms arbuscular mycorrhizal associations
- Mainly self-pollinate (wind); small % cross-pollinate
- Rated 'Efficient' at scavenging P & K from soil
- Perennial varieties used as cattle forage

Annual Peanut - *Arachis hypogaea*

Perennial Peanut - *Arachis glabrata*

◈ *Back to Cover Crop Chart*

Warm Season Legume

Amaranth
(*Amaranthus sp.*)

- Warm Season, broadleaf
- Annual
- Upright plant architecture
- Over 50 species; some exhibiting glyphosate resistance
- Low water use
- Tolerant of heat and drought
- Seeding depth: ½ – 2 inches
- Crude protein: ≈14%
- Does not form arbuscular mycorrhizal associations
- Self-pollinated (wind)
- Flowers may attract pollinators

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Buckwheat

(*Fagopyrum esculentum* Moench; *Fagopyrum sagittatum* Gilib)

- Cool Season, broadleaf
- Warm season growth characteristics
- Annual
- Upright plant architecture
- Medium water use
- Poor salinity tolerance
- Enhances soil P availability
- Seeding depth: ½ inch
- Crude protein: straw 5%, grain 13%
- C:N ratio: leaf 8-10, stem 12-32, root 28-47
- Does not form arbuscular mycorrhizal associations
- Attracts pollinators

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Quinoa
(*Chenopodium quinoa* Willd.)

- Warm season, broadleaf
- Annual
- Upright plant architecture
- Moderate water use
- Good salinity tolerance
- Seeding depth: ½ - 1 inch
- Crude protein: 14%
- C:N ratio: 14-25
- Does not form arbuscular mycorrhizal associations
- Self pollinates (wind); up to 15% may cross-pollinate
- Not susceptible to cereal diseases; slightly vulnerable to soil nematodes
- No registered herbicides for quinoa at this time

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Chicory
(*Cichorium intybus* L.)

- Warm Season, broadleaf
- Perennial
- Upright and spreading plant architecture (vine)
- Alternate names: French endive, succory
- Medium water use
- Seeding depth: ⅛ – ½ inch
- Crude protein: 10-32%
- Forms arbuscular mycorrhizal associations
- Attracts pollinators
- Rated 'very good' at scavenging nitrogen from the soil
- Highly invasive

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Cucurbita sp.
Family

- This is a broad grouping including squash, gourd, cucumber, melon, and pumpkin
- Warm Season, broadleaf
- Annual
- Prostrate plant architecture (vine)
- Seeding depth: ½ – 1 inch
- Forms arbuscular mycorrhizal associations
- Attracts pollinators
- Can be used for weed suppression as a 'smother crop'

Photos by Howard F. Schwartz Colorado State University, www.Bugwood.org

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Safflower
(*Carthamus tinctorius* L.)

- Warm Season, broadleaf
- Annual
- Upright plant architecture
- High water use
- Good salinity tolerance
- Deep rooted
- Effective at 'mining' mobile nutrients deep in the soil profile
- Seeding depth: 1 – 1 ½ inch
- Crude protein: hay 10-13%, grain 18%
- C:N ratio: leaf 21, stem 56, root 73
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Sunflower
(*Helianthus annuus* L.)

- C3 plant with warm season growth characteristics, broadleaf
- Annual
- Upright plant architecture
- High water use
- Fair salinity tolerance
- Deep rooted
- Effective at 'mining' mobile nutrients deep in the soil profile
- Seeding depth: 1 – 3 ½ inches
- Crude protein: silage 11-12%, grain 20-28%
- C:N ratio: leaf 11-14, stem 41-46, root 50-68, flower 14-19
- Forms arbuscular mycorrhizal associations
- Flowers attract pollinators

◈ ***View table for known crop sequence effects***

USDA-ARS, NGPRL

USDA-NRCS,
Bismarck Plant Materials Center

◈ *Back to Cover Crop Chart*

Warm Season Broadleaf

Foxtail Millet
(*Setaria italica* L.)

- Warm Season, grass
- Annual
- Upright plant architecture
- Low water use
- Poor salinity tolerance
- Seeding depth: 1 inch
- Crude protein: hay 15%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ *Back to Cover Crop Chart*

Pearl Millet
(*Pennisetum glaucum* L.)

- Warm Season, grass
- Annual
- Upright plant architecture
- Low water use
- Poor salinity tolerance
- Seeding depth: ½ – 1 inch
- Crude protein: hay 13%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Proso Millet
(*Panicum milaceum* L.)

- Warm Season, grass
- Annual
- Upright plant architecture
- Medium water use
- Poor salinity tolerance
- Seeding depth: 1 inch
- Crude protein: hay 10%
- C:N ratio: leaf 12-16, stem 12-35, root 17-26
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ *View table for known crop sequence effects*

◈ *Back to Cover Crop Chart*

Warm Season Grass

Grain Sorghum
(*Sorghum bicolor* L. Moench)

- Warm Season, grass
- Annual
- Upright plant architecture
- Alternate name: Sorghum-sudan grass

  **Grain sorghum and sudan grass were formerly separate species that have been combined. They are separated in the chart due to different plant attributes.*
- Medium water use
- Fair salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: hay 7%, stover 5%, grain 10%
- C:N ratio: leaf 11-17, stem 10-27, root 22-30
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)
- Stress conditions that limit growth (e.g., drought, frost) can contribute to prussic acid accumulation in leaves

◈ ***View table for known crop sequence effects***

◈ *Back to Cover Crop Chart*

Sudan grass
(*Sorghum bicolor* L. Moench)

- Warm Season, grass
- Annual
- Upright plant architecture
- Alternate name: Sorghum-sudan grass

  **Grain sorghum and sudan grass were formerly separate species that have been combined. They are separated in the chart due to different plant attributes.*
- Medium water use
- Fair salinity tolerance
- Seeding depth: 1 inch
- Crude protein: hay 7-11%, silage 6-17%
- C:N ratio: 48 - 63
- Forms arbuscular mycorrhizal associations
- Rated 'Excellent' at nutrient scavenging
- Self pollinator (wind)
- Stress conditions that limit growth (e.g., drought, frost) can contribute to prussic acid accumulation in leaves
- Known alleopathic effects on annual ryegrass

◈ *Back to Cover Crop Chart*

Teff
(*Eragrostis tef* (Zuccagni) Trotter)

- Warm Season, grass
- Annual
- Upright plant architecture
- Medium water use
- Poor salinity tolerance
- Seeding depth: ½ inch
- Crude protein: 10-18%
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ *Back to Cover Crop Chart*

Warm Season Grass

Corn
(*Zea mays* L.)

- Warm Season, grass
- Annual
- Upright plant architecture
- High water use
- Poor salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: grain 9-10%, stover 5%, silage 8-11%
- C:N ratio: stalk 11-65, leaf 13-20, root 20-49
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)

◈ ***<u>View table for known crop sequence effects</u>***

◈ *Back to Cover Crop Chart*