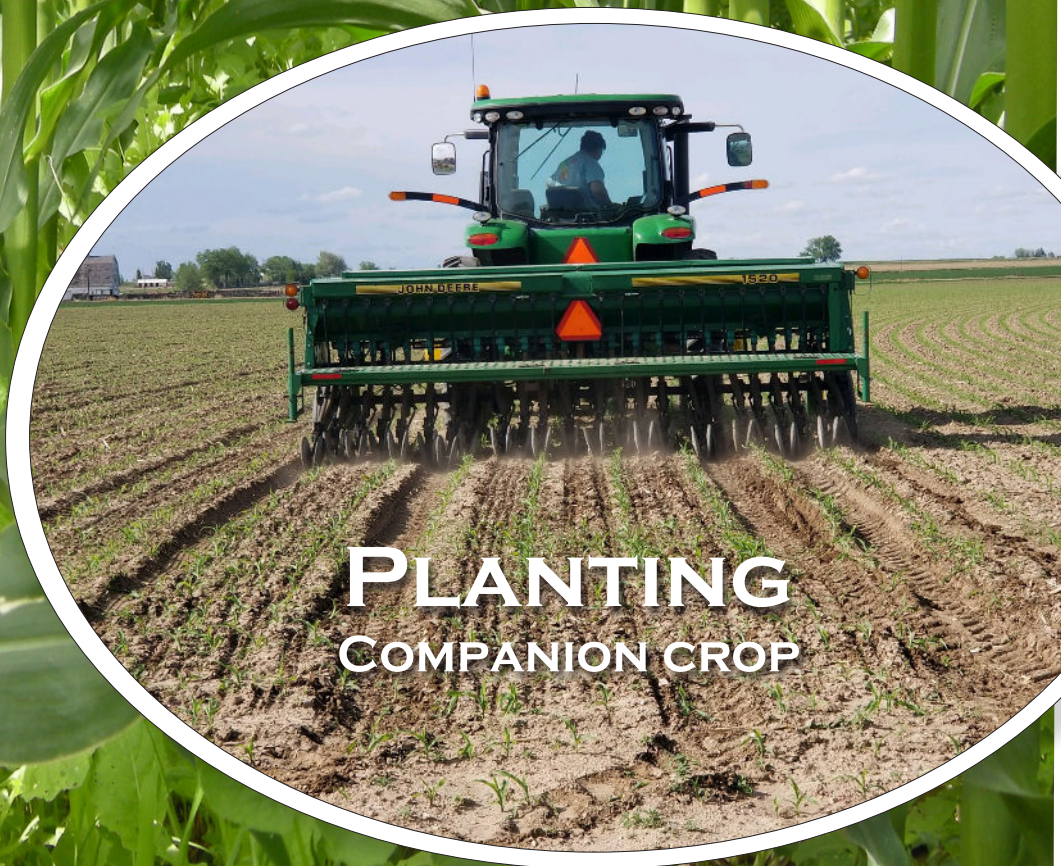
Buffalo BRAND SEED

GREELEY, COLORADO

TARGETED COMPANION AND COVER CROP



PLANTING
COMPANION CROP

FORAGE OPPORTUNITIES
SOIL IMPROVEMENT
WEED AND INSECT SUPRESSION

COVER CROPS OR COMPANION CROPPING?

By: Dennis Schwartzkopf & Greg Winter

The use of cover crops in a crop rotation is a well-known practice to build soil health and put nutrients back into the ground. But have you ever thought about planting a cover crop with your cash crop? This practice is called companion cropping. Before we jump into the benefits about companion cropping, let's review what cover crops are and the benefits they provide.

Cover crops are plants or a mixture of plants that are grown during a fallow period between cash crops. These cover crops are usually either grazed or left for decomposition. This becomes a vital part of the regenerative agricultural system by providing a unique delivery system for many ecosystems. Cover crops are known to improve soil in a number of ways including protecting against soil loss from erosion as well as providing organic matter, which encourages beneficial soil microbial life. For every 1% of organic matter increased in the top foot of soil, you will have an additional 20,000 gallons of water holding capacity per acre. They also:

1. Catch nutrients before they leach out of the soil profile
2. Roots that unlock nutrients, converting them into more available forms
3. Provide habitat or food source for important soil organisms
4. Break up compacted soil layers
5. Increase the soil's ability to absorb and hold water through improvement in pore structure

Companion crops are a cover crop grown with a cash crop at a lower seeding rate. The companion crop consists of a diverse mixture of plant species to feed the cash crop as well as provide a habitat for a beneficial insect population. This is a new technique but has grown tremendously in the past five years. We have especially seen an increase in seeding a companion crop during the corn V4-V7 stage with a seeding rate of 10 to 14 pounds per acre. Seventy five percent of the fields where this has been done have shown a yield increase.

In addition to the above benefits of cover crops, when you use cover crops as a companion crop in your field, you will also see these benefits:

1. Suppressed weeds, the cover crop acts as a smother crop, outcompeting weeds for water and nutrients
2. Growing leaf canopy that creates its own micro-environment to:
    a. Blocks light, altering the frequency of light waves which lowers the soil surface and air temperature by ten degrees or more.
    b. Lower the evaporation rate
3. Beneficial microbial life that discourages disease by creating an inhospitable soil environment for many soil borne diseases
4. Beneficial insect predators and parasitoids that can reduce insect damage below economic thresholds and produce compounds that reduce nematode pest populations

We encourage you to experiment with companion cropping on a small scale this year! Be sure to check with your crop insurance agent to make sure you maintain compliance before doing so.

Photo by: Dennis Schwartzkopf

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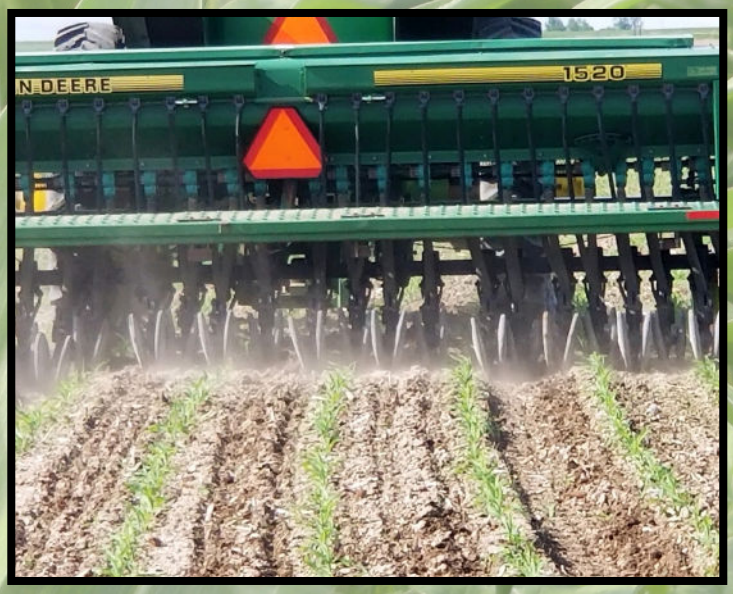

Planting at V4

Height of corn at drilling

July

Late July

Late August

COVER/ COMPANION CROP

Characteristics at a Glance

	Cover/ Companion Crop	Minimum / Optimum (°F) Germination Temperature	Maximum / Optimum Seeding Depth (Inches)	Monoculture Seeding Rate (lbs./acre)	Nutrient Repositioning to Surface	Timing of Nutrient Release	Durability of Dead Mulch Cover	Improved Infiltration	Break-up of Compacted Soil Layers	Weed Suppression (in Cover Crop Season)	Approximate Seeds per pound*
BRASSICAS	**Forage Turnip (Malwira)**	40/45-90°	.50/.25	4-6	G-E	F	VS	E	E	G-E	170,000
	Forage Rape	40/45-90°	.75/.25	4	G-E	F	VS	E	E	G-E	170,000
	Fodder Radish (Farmer)	40/45-90°	.50/.25	15-18	G-E	F	VS	E	E	G-E	50,000
	Daikon Radish	40/45-90°	.75/.25	7-10	E	F	VS	E	E	G-E	50,000
	Purple Top Turnip	40/45-90°	.75/.25	8-10	G	F	VS	G	G	G	170,000°
CEREALS & GRASSES	**Buffalo Honey**	60/70°	2.5/1.5	12-28	G-E	S	L	M	P	G	15,000
	Buffalo Honey BMR	60/70°	2.5/1.5	12-28	G-E	S	L	M	P	G	18,500
	Pearl Millet	65/75°	1/.75	8-18	G-E	S	L	M	P	G	84,500
	Oats	43-45/ 68-75°	2/1	50-90	G	M	M	M	P	G	19,600
	Fall Triticale	42/68°	2/1	50-100	G	M	M	M	P	G	22,700
	Winter Barley	40/68°	2/1	55-90	G	M	M	M	P	G	13,600
	Italian Annual Ryegrass	38/65°	.50/.25	30-40	G	M	M	M	P	G	224,000
	Annual Ryegrass	38/65°	.75/.25	12-18	G	M	M	M	P	G	200,000
LEGUMES	**Austrian Winter Peas (Cool Season)**	40/55°	2/1.5	25-35	M	F	VS	M	P	M	5,000
	Forage Peas (Cool Season)	40/50°	2/1.5	25-30	M	F	VS	M	P	M	5,000
	Hairy Vetch	45/68°	1/0.5	15-18	M	F	VS	M	P	G	16,400
	Medium Red Clover	41/77°	.75/.25	6-10	M	F	VS	M	M	G	285,000
	Crimson Clover	41/77°	.25/.50	10-15	M	F	VS	M	P	G	145,000
	Berseem Clover (Winner)	41/77°	.25/.50	8-12	M	G	VS	M	G	E	145,000
	Cowpeas (Warm Season)	65/75-80°	2/1.5	40-60	M	F	VS	M	M	G	4,000
	Buckwheat (Warm Season)	45/65-80°	1.5/1	40-50	M	F	G	G	E	E	20,000

CHART ABBREVIATIONS

VS = very short	P = poor	M = moderate	G = good	S = slow	E = excellent

Minimum/ Optimum Germination Temperatures: The range of germination temperatures to which each crop is adapted.

Maximum/ Optimum Seeding Depths, Inches: The depth of emergence capabilities of each crop.

Monoculture Seeding Rates Per Acre: Suggested range of seeding rates across low moisture/ high moisture environments when planted alone. When planting seed mixes, it is suggested that each cover crop be assigned a desired percentage and seeding rates adjusted accordingly.

**Approximate seeds per pound is provided as an aid to planning, and varies. Buffalo Brand Seed does not imply or warrant that seed will be of the count per pound listed above.*

Nutrient Repositioning to Surface: Relative ability of a cover crop to move nutrients closer to the surface from deep in the soil profile, thereby improving fertility that is available to seedling cash crops that follow the cover crop.

Timing of Nutrient Release: Cover crops that decay quickly make beneficial nutrients available for cash crops that are planted soon after cover crop termination. Slower decaying, delayed nutrient release may be optimum when cash crop planting is delayed.

Breakup of Compacted Soil Layers: Cover crops with demonstrated ability to extend root growth through compaction zones.

Durability of Dead Mulch: Highly durable, long lasting mulches are desirable where maintaining maximum cover is the first priority. Short lived mulches allow the soil to warm up quickly in the spring and can be desirable when extended cover is not needed.

Improved Infiltration: This is a rating of a cover crop's ability to improve soil surface permeability for increased rate of water absorption.

Weed Suppression During Cover Crop Season: This is a rating of a cover crop's ability to limit weed growth as a result of competition for sunlight and soil moisture as well as possible alleopathic suppression.

Cover Crop

A fast-growing crop planted to build soil structure and organic matter, prevent soil erosion and improve nutrient availability. Cover crops are grown either in the season during which cash crops are not grown or between the rows of some crops. Cover crops may be planted as a single species or mix of species dependent upon the goals developed for each field.

Selecting Cover Crop Mixes

* *What are your needs?*
* *Spring plant, Summer plant, Fall plant?*
* *Cover only? Grazing? Haying?*
* *Fall Planting - Do you want the mix to freeze out or overwinter?*

Standardized Targeted Cover Crop Mixes

Green Manure Mix

Soil Improvement

Biomass Production in gardens
Suggested planting rate - 1#/1000 sq. ft.
50# bags, Totes avail. upon request

30% Austrian Winter Peas
25% Common Vetch
15% Hairy Winter Vetch
15% Oats
15% Winter Rye
**mix is innoculated*

Spring Oats & Field Pea Mixes

Grazing/Haying

Plant - early spring
Suggested planting rate - 100lbs/acre
50# bags and 2000# totes

60% Oats
40% Forage Peas

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Standardized Targeted Cover Crop Mixes cont...

Spring Cropper Mix

Grazing/Haying

Plant - early spring when soil temp is 40°F+
Suggested planting rate - 50lbs/acre
50# Bags and 2000# Totes

60% Oats
30% Forage Peas
4% Diakon Radish
4% Purple Top Turnip
2% Forage Rape

Summer Cropper Mix

Grazing/haying/cover

Plant - After wheat harvest
Suggested planting rate - 34lbs/acre
50# Bags and 2000# Totes

60% Forage Peas
15% Forage Soybeans
15% Sorghum X Sudangrass
5% Diakon Radish
2.5% Purple Top Turnip
2.5% Forage Rape

Fall Cropper T Mix

Grazing/cover

Plant - August 1-15 • Optimum Biomass Production Triticale should overwinter & rape seed has the potential to also, depending on growth stage & winter severity.
Suggested planting rate - 58lbs/acre
50# Bags and 2000# Totes

65% Fall Triticale
20% Forage Peas
5% Sorghum X Sudangrass
4% Forage Rape
4% Diakon Radish
2% Purple Top Turnip

Fall Cropper B Mix

Grazing/cover

Plant - August 1-15 • Optimum Biomass Production & superior feed value from Barley. Barley and Rape should overwinter, depending on growth stage & winter severity.
Suggested planting rate - 58lbs/acre
50# Bags and 2000# Totes

65% Fall Barley
20% Forage Peas
5% Sorghum X Sudangrass
4% Forage Rape
4% Diakon Radish
2% Purple Top Turnip

Fall Cropper Oat Mix

Grazing/Cover

Plant - August 1-15 • Optimum Biomass Production Mix will not overwinter, eliminating need to terminate in spring.
Suggested planting rate - 62lbs/acre
50# Bags and 2000# Totes

65% Oats
25% Forage Peas
5% Forage Rape
2.5% Diakon Radish
2.5% Purple Top Turnip

Companion Crops Mix #3

44% Italian Annual Ryegrass
14% Diakon Radish
14% Purple Top Turnip
14% Medium Red Clover
7% Forage Rape
7% Buckwheat

Suggested seeding rate - 14 lbs/acre
Totes available upon request

For more information on Standardized & Custom Mixes call 800-421-4234

* Small seeded Brassicas are coated to improve canopy penetration and germination/seedling establishment.

Brassicas : versatile cool season annuals are effective cover crops when planted in late summer/ early fall or late winter/ early spring and able to germinate efficiently over a broad range of seed bed temperatures. Brassicas are highly palatable to grazing animals. Aggressive growth suppresses weeds, in addition radishes can have a "preemergent herbicide" effect on some weed species due to alleopathy.

Brassicas move nitrogen and other nutrients scavenged from the subsoil to the upper portions of the plant. This "nutrient recycling" benefit starts to accrue early, within a few weeks of planting. Winter killed plants decay rapidly and deposit absorbed nutrients near the soil surface. Increased biological activity and enhanced fertility levels at the soil surface contribute to vigorous growth by cash crop seedlings and may speed the decomposition of crop residue.

Tillage, compaction reduction and infiltration improvement are best achieved with early seeded brassicas that are given adequate time to develop large roots. Brassicas are sensitive to residual levels of some herbicides, particularly triazines and ALS inhibitors. Radishes have been proven to reduce nematode populations and as a class are considered among the most effective biological tillage plants. The addition of 2 to 3 pounds of radish seed per acre to cash crop winter wheat plantings is gaining in popularity as producers observe increased wheat yields due to this practice. Decomposing radishes smell like rotten eggs, an aroma that is noticeable in the vicinity of the field where they were grown. Most varieties of radish used for cover crop originated from oil seed radish genetics and have been breed to favor either tillage or forage production.

Turnips excel as forage providers since top growth and tubers are palatable and efficiently utilized by grazing animals.

Forage Turnip:
A hybrid cross between a turnip and a rape. The Forage Turnip is bred for fast establishment, with utilization possible in 45-55 days. Similar to a non-bulb producing turnip, only much leafier with vigorous regrowth and fast recovery from grazing. The Forage Turnip has the ability to yield well into the fourth regrowth cycle with adequate moisture. Does well in heavier soils, but prefers more moisture .

Forage Rape:
Cross between a turnip and a kale, generally called a rape. The most versatile brassica, suitable for a wide range of soil fertility and environmental conditions. Early maturing, extremely drought tolerant and suitable for grazing 45-60 days after seeding. Excellent frost tolerance for extended early winter grazing, and will probably over winter. Exceptional regrowth characteristics, up to 3-4 cycles. Has an upright growth habit, so it is less competitive for space.

Fodder Radish:
Fodder radishes are used as a biofumigant to help control nematodes and other pathogens. Fodder radishes have more top growth than daikon, enabling them to cover the ground quicker and be more effective in shading out weeds. The tuber on fodder radishes are not as large as daikon but will still reduce compaction and soil health. The fodder radish is similar to daikon in that they have fast seedling development and a deep well developed root system.

Tillage Radish:
Long taproots of moderate circumference are especially well suited to deep biological tillage. As compared to traditional Daikon radishes, Tillage Radish exhibit prolonged vegetative growth, delayed flowering and taproots of smaller circumference but deeper growth. This combination maximizes the potential for consistent, effective biological tillage. Tillage Radish provide the best possible soil preparation for a successful follow crop.

Daikon Type Tillage Radish:
The original biological tillage crop, Daikons produce moderate length taproots of large circumference. Moderate length taproots of large circumference are optimum for opening the soil surface for increased infiltration.

Purple Top Turnip:
Grazing animals will utilize forage above ground as well as the roots. 1.5 to 3 pounds of turnip seed per acre, when added to plantings of winter annual cereal grains, can improve forage production. Turnips may extend the fall grazing period after cereal grains have gone dormant since animals harvest the tubers with increased frequency during that period.

Cereals & Grasses :

produce extensive fibrous root systems that build soil structure, increase organic matter and move deep nutrients to the soil surface. These plants were made to be grazed with good regrowth after clipping. A thick stand of grass/cereal cover crop helps suppress weeds. Excellent choice for grazing, hay, soil building or mulch cover.

- Forage Producers
- Suppress Weeds
- Nutrient Recycling
- Mulch Covering

Buffalo Honey -
Sorghum Sudangrass Hybrid:

Warm season annual grasses with fast summer growth, regrowth after clipping and drought tolerance with a deep root system. Buffalo Honey is capable of producing significant biomass when planted as late as mid August on the central and southern plains. Better iron chlorosis tolerance than forage or grain sorghums. Minimum soil germination temperature is 60 F. Grazing should be delayed until plants have completed the initial 24 inches of growth. Durable mulch cover is best achieved with planting rates of approximately 6 to 8 lbs per acre which produces a somewhat stemy growth. Sorghum sudangrass has been documented to reduce some nematode populations. Plant 18 to 30 pounds per acre for optimal grazing.

Buffalo Honey BMR
Sorghum Sudangrass Hybrid:

Similar to Buffalo Honey regarding growth characteristics and uses, with forage of superior palatability and digestibility.

Hybrid Pearl Millet:

This warm season annual grass is similar to sorghum sudangrass in that it regrows well after clipping and is drought tolerant. Germination requires minimum soil temperatures of about 65 F. Pearl millet has no prussic acid risk but is more prone to nitrate toxicity than sorghum sudangrass. Excellent iron chlorosis tolerance. For durable mulch plant 4 to 7 lbs per acre, optimal grazing requires 15 to 18 lbs per acre.

Fall Triticale:

Cool season winter annual cereal originally developed from a cross between wheat and rye. It can be planted in the fall approximately 30 days earlier than wheat because of superior disease resistance. Good winter hardiness. A high production forage with palatability somewhat lower than wheat. It produces especially well in the spring.

Oats:

Cool season annual cereal, effectively used as a cover crop in either spring or fall. Oats planted in the fall will usually winter kill any where north of central Oklahoma and the southern Texas panhandle, leaving standing dry hay.

Winter Barley:

Cool season winter annual cereal with good forage production capabilities for haying or grazing. Good salinity tolerance and winter hardiness. Barley is considered to have superior forage quality as compared to other winter annual cereal grains. Barley exhibits more autumn growth than other winter annual cereals.

Annual Ryegrass:

Cool season annual grass with a deep, prolific root system. Annual ryegrass must be seeded relatively shallow but is fast to sprout. If allowed to set seed it can become a weed in winter cereals such as wheat.

Italian Annual Ryegrass:

A cool season annual ryegrass with superior yield, quick establishment and drought tolerance. Perfect for alfalfa or clover mixtures and highly palatable, digestable and nutritious.

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Legumes : Nitrogen is the most critical fertility element for most crops but is the only element that is not released to the soil from the parent minerals. Nature transfers nitrogen from the atmosphere to the soil through rainfall and the symbiotic relationship of legumes with rhizobium bacteria. Each family of legumes requires a specific race of rhizobium which is unlikely to occur naturally in significant numbers within the field where the legume is to be planted. Maximum nitrogen fixation is best achieved when the correct rhizobium inoculant is applied to the seed. Legumes planted as seed mixes should be inoculated at a heavy rate to compensate for the "dilution" of inoculant material on non legume seed.

Austrian Winter Pea (Cool Season):
Winter annual legume that grows rapidly in cool, moist weather. Austrian Winter Peas generally survive the winter south of the Kansas/ Oklahoma border, with less dependable winter hardiness north of that point. Most often planted in the fall. Excellent forage quality that is good for haying. Little or no regrowth after grazing. Seed may be planted as deep as 3 inches if necessary and should be placed with moist soil above and below the seed since germination moisture requirements are high. Use pea, vetch, lentil inoculants; N-Dure for Cool Season: Rhizobium leguminosarum biovar viceae.

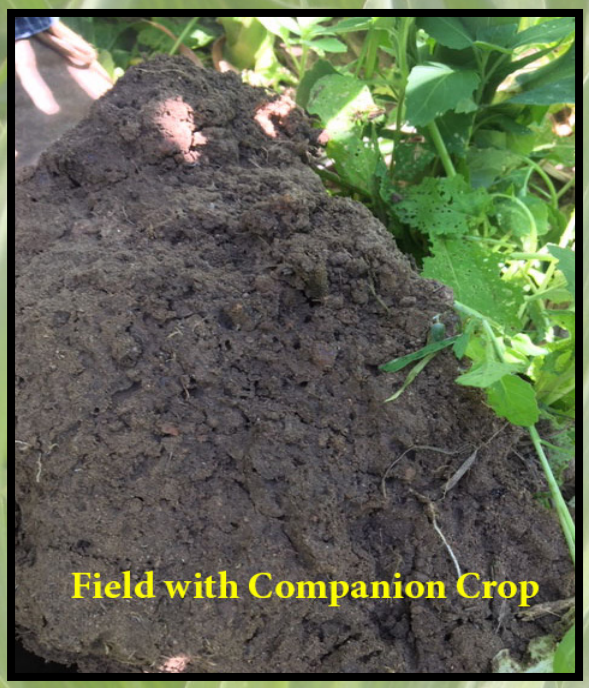
Forage Peas (Cool Season):
This cool season annual legume is a spring growth habit version of the Austrian Winter Pea, similar to the growth pattern of spring wheat as compared to winter wheat. Planted as either a spring or fall seeded cover crop, it will winter kill when planted in the fall. Forage quality, planting requirements and regrowth characteristics are similar to Austrian Winter Peas. Use pea, vetch, lentil inoculant ; N-Dure for Cool Season: Rhizobium leguminosarum biovar viceae.

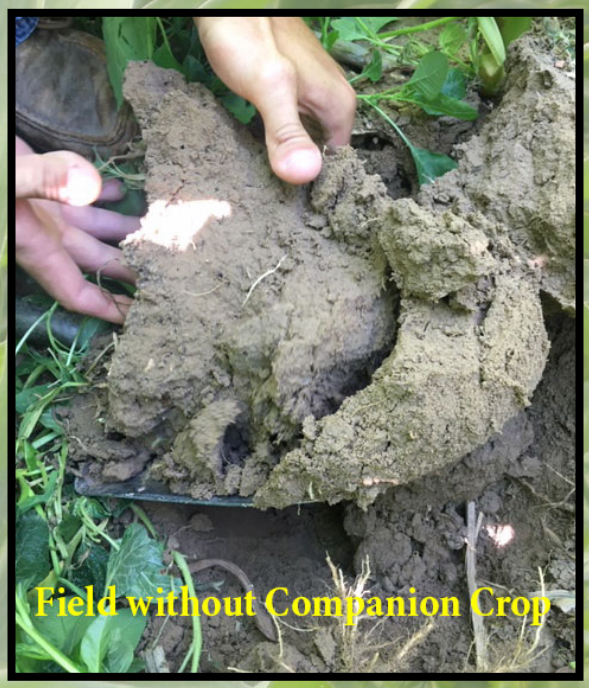
Hairy Vetch:
This legume can function as a fall seeded winter annual legume or as a spring seeded cool season annual legume. It is an excellent nitrogen fixer and good forage for haying or grazing. It has vining fine stems up to 12" long. It will generally survive over the winter in Kansas with occasional winter kill. Winter survivability is enhanced when planted with a companion cereal crop. Good for soil health. Hairy Vetch seed may have dormancies as high as 30%. It should be destroyed prior to seed formation in any crop rotation that includes winter annual cereal production such as winter wheat so that it does not become a weed problem. Use pea, vetch, lentil inoculants; N-Dure for Cool Season: Rhizobium leguminosarum biovar viceae.

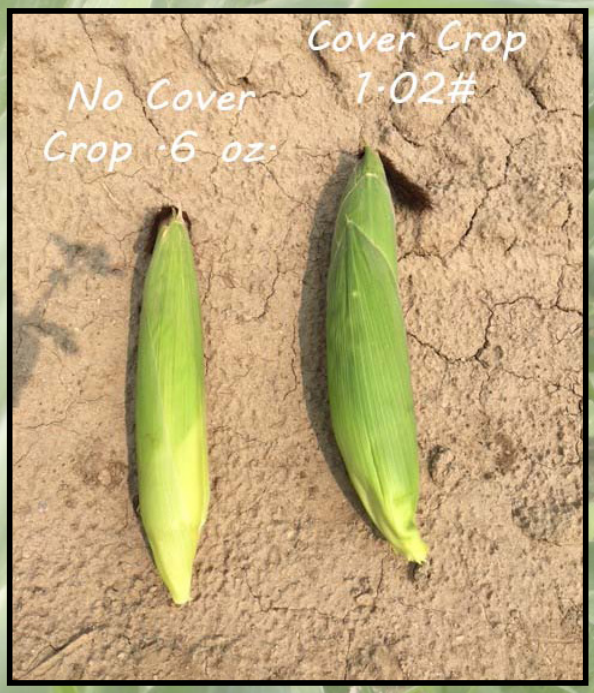
Medium Red Clover:
A short lived perennial legume that thrives wherever corn grows. Good shade tolerance and cool soil germination capability (41F) make it an excellent companion to grains. It is an aggressive nitrogen fixer, helps suppress weeds and breaks up heavy compacted soils, but is widely adapted to most soil textures. Great for haying, grazing, plow down or no till wilt down. Use N-Dure for alfalfa/sweet clover/ true clover inoculant combination: Sinorhizobium meliloti and Rhizobium leguminosarum biovar trifolii.

Berseem Clover:
Can be planted as a fast growing summer annual legume by itself or with alfalfa to increase forage production. In Northern climates it is best used as a spring seeded annual, but can also be planted as a late summer annual to provide winter cover and mulch residue. Berseem clover is a good N. scavenger and is capable of fixing 100-125 pounds of N. Prefers slightly alkaline, loamy and silty soil. Can grow 18"-30" tall and has a small taproot system that is 4-6 inches long and does not cause bloat.

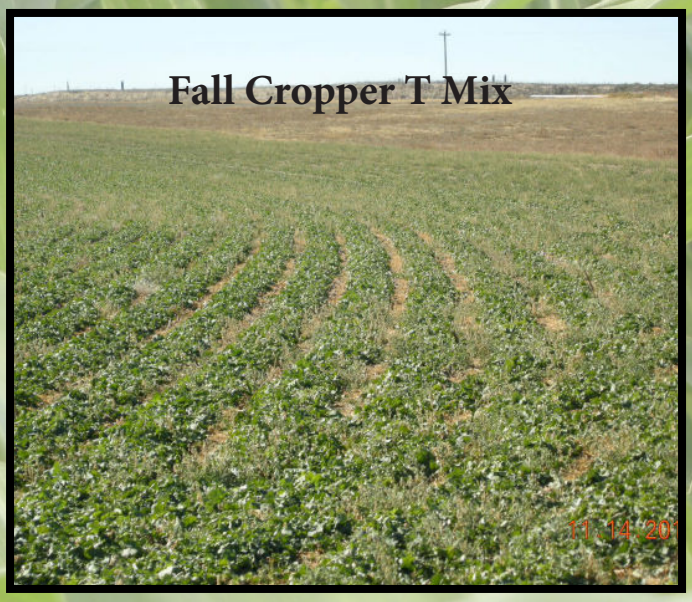
Soil Differences Companion Crop field - Colorado

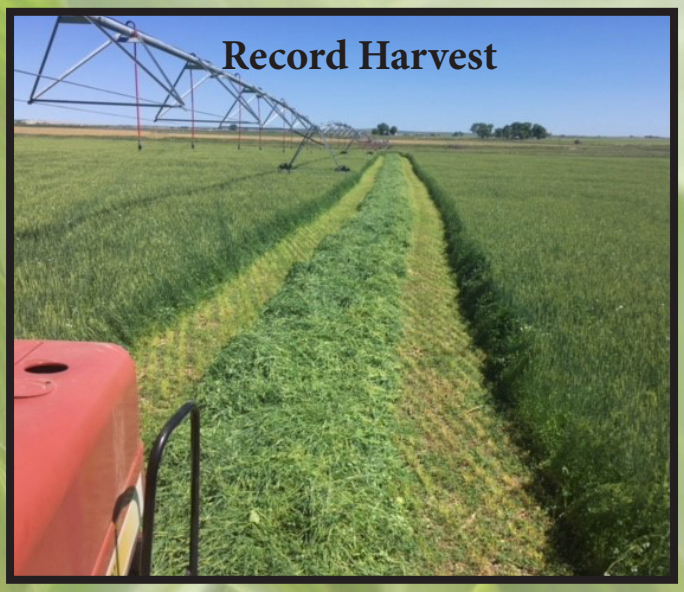






Building healthy soil, one year at a time!





Companion Crop in Sugar Beets

Buffalo

GREELEY, COLORADO

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