

2013 Resource Guide



TILLAGE RADISH®

TILLAGE ROOTMAX™ DEEP ROOT ANNUAL RYEGRASS

TILLAGE SUNN™ SUNN HEMP

TILLAGEMAX MIXES, FEATURING TILLAGE RADISH®

CCS COVER CROP SELECTIONS

The Benchmark of Quality in Cover Crops

Cover Crop Solutions is a seed company that stands for something new in agriculture.

What's new is a fresh approach to cover cropping and to the discovery of ways it increases plant and soil production.

Advancements are being made in cover crops to enhance soil health and increase nutrient management while providing a living cover during the off season. Cover crops are proving to further enhance cash crop yields, build top soil, increase earthworms and improve soil and plant health in ways that pay.

Cover Crop Solutions stands on the principle of using cover crops to make a positive contribution to the farm's bottom line.

For us, it's all about building and maintaining a high level of soil health so that this incredible food-generating engine can function at peak performance. Cover crops are a key tool in this "soil first" approach to higher yields and even more robust bottom lines.

That's why we are so highly focused on cover crops that are not only unique, but are also certified for genetic purity. And it's why we support ongoing university and highly controlled farm-based research to stay at the forefront of the science of cover crops.

Ask us to show you how cover crops are a proven way to reduce input costs without compromising high yields, and why we produce and supply "cover crops that pay."



A Word from Steve Groff



Farmer and cover crop innovator
Cedar Meadow Farm
Holtwood, PA

We have fields at our farm that have not seen tillage equipment in 30 years. My interest in cover crops started with knowing that uncovered soil easily erodes into places like our nearby Chesapeake Bay. Working with university researchers like Dr. Ray Weil from the University of Maryland, however, gave me an entirely different respect for what good management can mean in terms of the soil's response to practical, common sense approaches to building soil health.

Out of helping test and develop the Tillage Radish®, one of the most remarkable advances in cover crops in recent memory, Cover Crop Solutions was founded on the idea of being one of the farmer's best friends.

As one of the company's partners, I will always be a farmer first and foremost. As a farmer, we are stewards of the land, the growers of food, and producers of many raw materials with all kinds of industrial applications.

Thank you for your commitment to learning how cover crops will help keep our soils healthy, productive and sustainable.

Treat Cover Crops Like Your Cash Crops!

Here are 10 tips to help you tackle cover crop seed selection:

1 Performance over price

Just like you purchase seed corn, soybeans, and other cash crop seed, buy cover crop seeds on value with seed genetics that produce the traits and benefits you desire. Utilize knowledgeable Cover Crop Solutions seed dealers who provide resources and experience that help you choose cover crops that pay.

2 Spread risk

Follow the fundamentals of cash crop establishment and plant as soon as possible after harvest or prior to harvest. Plant for diversity, or with multi-specie mixes, to lessen weather risks, break pest cycles and prevent erosion that some monoculture species are vulnerable to.

3 Use test plots

A cover crop test plot on your farm is the best way to really know how cover crops work for you. Have a check strip adjacent to your test plots to show a comparison to help determine benefits.

4 Plan ahead

It's simple: improved cover crops equal improved cash crops. Be prepared. Know your planting window. Have your seed available, equipment calibrated, and your workers prepared to plant.

5 On-farm testing & research

Collaborate with others, including Cover Crop Solutions, to replicate field scale research testing to give credible data for the real world. Follow up with a field day to show your neighbors and encourage what could work best for your area.

6 Follow a plan

Be strategic in determining which species to plant in front of the next cash crop. Generally legumes before corn and grasses before beans. Tillage Radish® can be planted before both, and TillageMax Mixes are becoming more popular. Consider adding wheat on a few acres or short season corn or soybeans to expand planting window opportunities.

7 Record keeping

As with cash crops, keep a record of cover crop planting dates, seeding rates, and other important details. Incorporate this information into your crop management programs: crop consulting, conservation plans, fertility, soil testing, yield testing, moisture and nutrient availability data. Make notes comparing soil quality, harvestability, and any issues that may need to be addressed.

8 Spread out harvest

Make more of your fields available for cover cropping. Consider planting short season hybrids and varieties, planting wheat, or including grazing in your rotation.

9 Fertility management

Legumes can add nitrogen while Tillage RootMax™ Deep Root Annual Ryegrass™ and Tillage Radish® can keep nitrogen from leaching into tile lines and groundwater. These cover crops can be a tool for nutrient management planning and for increasing soil biological activity.

10 Utilize your best resources

Seek knowledgeable Cover Crop Solutions seed dealers, university extension teams, NRCS personnel and websites that provide creditable cover crop information. Challenge yourself, your hired hands and the next generation in finding ways to incorporate cover cropping into your operation!



EXCLUSIVE Plant Variety Protection^{*}

After more than a decade of research and development, Tillage Radish[®] has been awarded PVP pending status and is now recognized as a unique radish variety. This means the Tillage Radish[®] genetic profile is different from any other cover crop radish in the world.

This also means no unauthorized propagation is allowed, so that farmers know exactly what they are getting inside of every bag of Tillage Radish[®] seed.

- Superior genetics in every bag
- Unique variety with over a decade of university research
- Proven research data: Yield increases for corn, soybeans and winter wheat
- Industry-leading seed grower program assures highest purity and performance
- Reliable, dependable cover crop performance, no unpleasant surprises
- No early bolting

^{*} Tillage Radish[®] - Variety CCS-779, produced by Cover Crop Solutions, LLC, has U.S. PVP #201200292. Under the U.S. PVP Statute, unauthorized propagation is strictly prohibited. U.S. Variety Protection applied for.

Tillage Radish® has unique and exclusive genetics specifically selected for use as a cover crop

CERTIFIED GENETIC PURITY



Certified Tillage Radish® seed delivers the consistent, desirable traits farmers have come to rely on for optimal soil health improvement and increased cash crop yields.



DESIRABLE TRAITS

Certified genetics in every bag	✓
Developed for aggressive single taproot	✓
Developed originally for use as a cover crop by Dr. Ray Weil and Steve Groff	✓
Backed by 12 yrs+ research	✓
Documented yield increases	✓
Late maturity, no early bolting	✓
Drilled seeding rates 6 lb/ac	✓



For every 100 seeds...

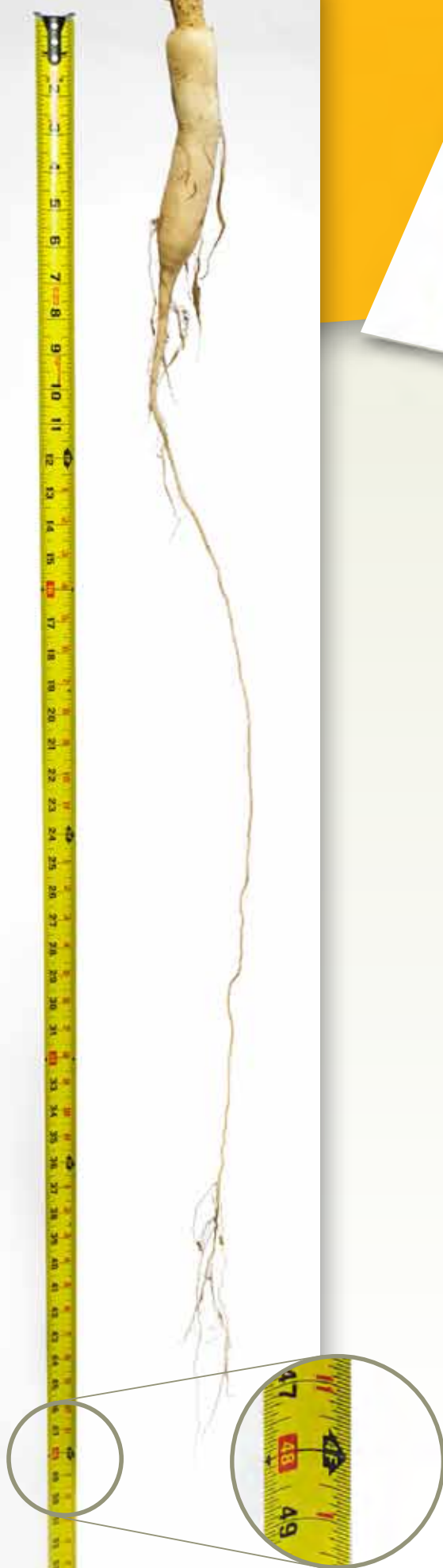
Tillage Radish® gives you certified genetics in every bag.



With non-certified seed you don't know what's in the bag.

Accept no substitutes. There are none.

For the best results with cover crop radishes, insist on Tillage Radish®, the **only** cover crop radish with proven claims and over a decade of proven history.



**Tillage
Radish®**
The Original and Only

GENETIC
Certified
PURITY



**If it isn't this bag,
it isn't Tillage Radish®.**

Available only from authorized dealers

Photo courtesy of Grant Heilman Photography, Lititz, PA

Tillage Radish® Growth Stages



1

Rapid Germination:

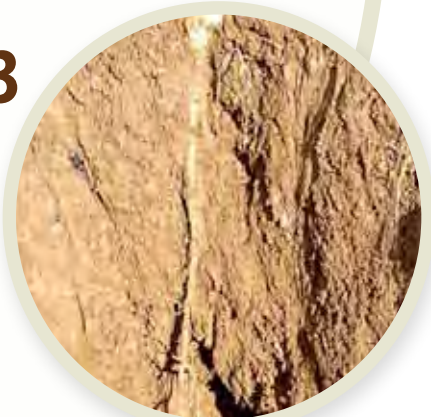
2-3 days with proper soil temperature and moisture



2

Weed Suppression:

Thick foliage shades out available space



3

Bio-Drilling Taproot:

Tuber narrows at compaction point, sending out the taproot, boring down into the subsoil up to 30" in depth



4

Nutrient Silos:

Enlarged tubers and thick foliage stockpile nutrients wicked up through the bio-drilling taproot



6

Seedbed Ready:

Residue has decayed, nutrients are available, and soil health and seeding conditions are enhanced



5

Winterkill:

Dies after 2-3 nights in the mid-teens, leaving a blanket of winter cover

The Cover Crop That PaysSM

FALL

PLANTING

Plant 3 to 10 weeks before the first killing frosts.

Radish size depends on growth time, plant competition and available nutrients to scavenge.

NUTRIENT SCAVENGING

Tillage Radish[®] absorbs nitrogen (N) and other key nutrients, including that from manure, and releases them in spring when cash crops need it most.

WINT

N WINTERS OVER

Tillage Radish[®] holds plant-available (N) and other soil nutrients. A few cold nights in the "mid-teens" kill them. If no killing frost, standard herbicide burndown is recommended.

If no killing frost, control with mowing, grazing or burndown with active ingredient Glyphosate 1 quart with 1 pint of 2,4-D equivalent at flowering.

Amazing unique taproot drills through the compaction zone where steel can't reach.

N
P
K
N
Ca
P
N
Ca
S

N S
K N
P
Ca

Soaks up (N) and other key soil nutrients, both above and below the compaction zone.

Ca P
N
S K
N N
N Ca
K S
P

Breaks up compaction zone, improves drainage and air movement deep in the soil.

TillageRadish.com

- Corn yields up average **12 bu/ac**
- Soybean yields up **8 bu/ac**
- Winter Wheat yields up to **5-7 bu/ac** increase*
- Over 12 years of university R&D
- Tillage Radish® is genetically superior

*This is planting 2-3 lbs of Tillage Radish® with winter wheat.



E R

WHAT WEEDS?

The dense Tillage Radish® foliage forms a thick canopy so most winter annual weeds never see the light of day. Herbicide burndown can be reduced.

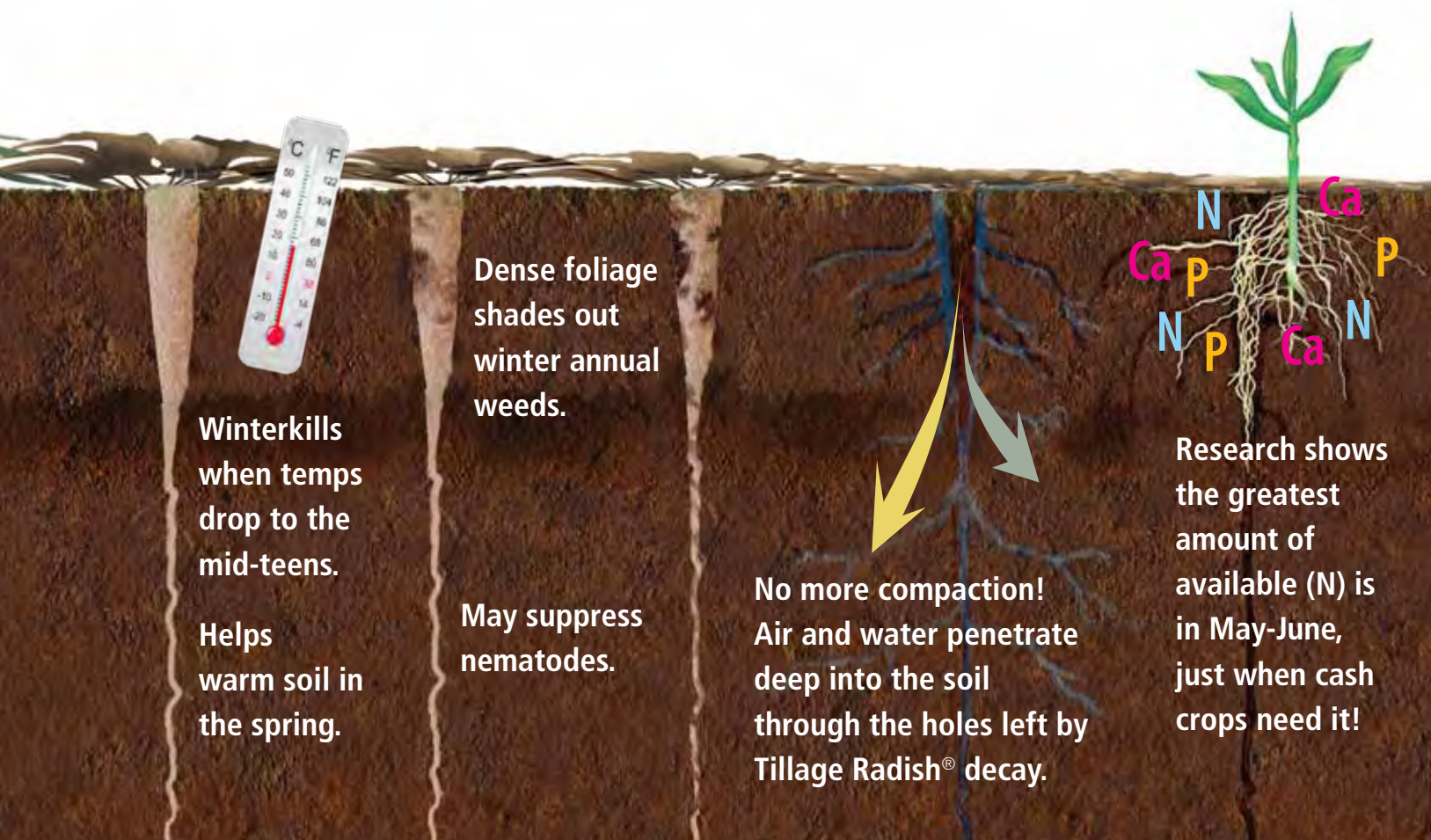
S P R I N G

SOIL CONDITIONING

As the Tillage Radish® decays, voids are left in the soil, with holes in the compaction zone created by the taproot. This means greater air and water circulation in the soil, increased microbial activity, and much easier planting.

DECAY AND RELEASE

As temperatures rise, the (N) is released back to the rhizosphere, the root zone, where it is available for the crop that follows Tillage Radish®.



TillageRadish.com

How it pays: Increases yields

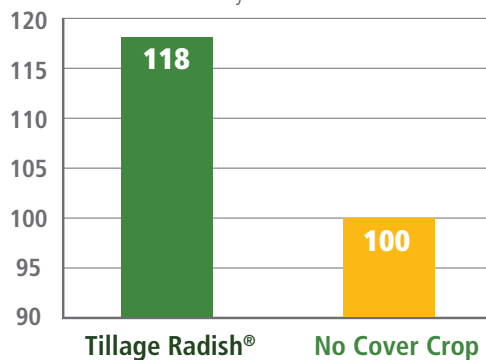
YIELDS

Both research and farmers confirm significant increases in yield and bottom line profits when using Tillage Radish®.

Corn & Soybean Yield Increases in Heavily Compacted Soils

CORN YIELD (BUSHELS / ACRE)*

Dr. Ray Weil, University of Maryland
Hayden 2005

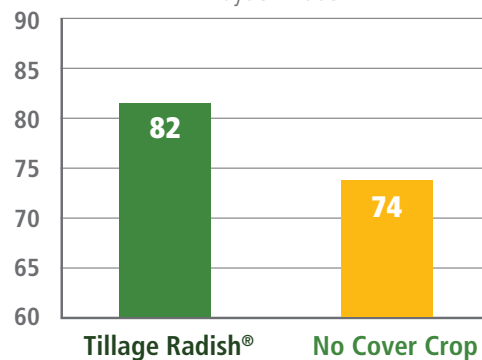


Yield with Tillage Radish® 118 bu/acre
vs No Cover Crop 100 bu/acre

**Data taken in dry year*

SOYBEAN YIELD (BUSHELS / ACRE)

Dr. Ray Weil, University of Maryland
Hayden 2005



Yield with Tillage Radish® 82 bu/acre
vs No Cover Crop 74 bu/acre

Tillage Radish® Benefit

10% yield increase or 18 bu/acre advantage
18 bu/acre @ \$6.50/bu = \$117/acre advantage

Tillage Radish® Benefit

11% yield increase or 8 bu/acre advantage
8 bu/acre @ \$13.50/bu = \$108/acre advantage



Results for Dan Magness of White Hall, MD

Tillage Radish® and Increased Corn Yields

No cover crop	180 bu/acre
Barley cover crop	193 bu/acre
Tillage Radish® cover crop	221 bu/acre
TOTAL INCREASE OF	41 bu/acre

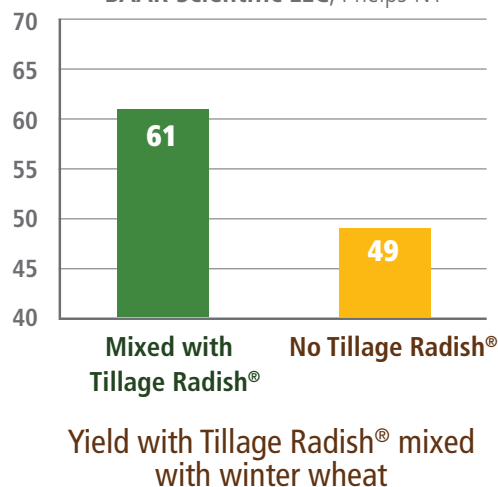
(Left) Dr. Ray Weil in a November Tillage Radish® field showing peak biomass, (N) uptake and fleshy development.* Photo: Remsfeld

*Size depends mainly on soil fertility, seeding rate and length of growth time.

Finding the Ideal Tillage Radish® & Winter Wheat Ratio

WHEAT YIELDS INCREASE (MIXED WITH Tillage Radish®)

BAAR Scientific LLC, Phelps NY



ONGOING RESEARCH, IMPORTANT FINDINGS

Research (chart above) shows that mixing 2 lbs of Tillage Radish® with winter wheat seeding can result in significant yield increases with beneficial results.

- The USDA is currently looking at this practice as part of risk management and cost share program eligibility.
- Third party research in replicated plots indicate a 5-7 bu/acre increase in cash grain winter wheat yield when 2-3 lbs of Tillage Radish® was planted with the winter wheat.
- A \$6.90 investment in Tillage Radish® (2 lbs/acre) is hard to pass up at \$7.00 per bushel of cash grain winter wheat.

Case Study: Winter Wheat with Tillage Radish® - Tony Kodesh of Red Rock, OK

I planted 3 lbs of Tillage Radish® into 400 acres of my winter wheat crop this past year to test it out. I had read about the benefit claims and considered it would be much like what my father did when he planted turnips with his wheat.

Unfortunately, this past year we had severe drought conditions that were comparable to that of the dust bowl period. The future of our crop looked grim and the Tillage Radish® tubers only got to be the size of pencils when they were winterkilled. Being so dry we were looking at the real possibility of needing to make a crop insurance claim.

Fortunately, we were blessed with rain a few weeks prior to harvesting - it saved the crop.

When we went to harvest, we were surprised to see that the fields where Tillage Radish® was planted showed yields of 9-15 bu more than any other of our wheat fields.

I am pleased with the results of using Tillage Radish® and appreciated the support I received from the Tillage Radish® team. I am looking forward to planting Tillage Radish® this year. I agree that Tillage Radish® is a cover crop that pays!

How it pays: Improves soil fertility

THE AMAZING TILLAGE RADISH® TAPROOT

Because of its unique plant characteristics, the Tillage Radish® cover crop provides measurable benefits to the farmer, the soil, and the environment all while being easy to manage. Successful farmers find that Tillage Radish® is the cover crop that pays with tangible benefits.

One of these unique traits is the taproot, which reaches depths of 30" and beyond! When it hits the compaction zone (around 290 PSI), the tuber stops and the taproot begins to bio-drill deep down into the subsoil.



(Top) Tillage Radish® 8 days after seeding showing developing taproot system. Within a month, the roots will reach depths of 30 inches and beyond.

(Bottom) Taken along plot boundary lines, the spinach on far left (see arrow) had no Tillage Radish®, while the spinach on far right was planted at the same time next to Tillage Radish® (decaying root visible; see arrow) and middle spinach in between.



Planted at same time, no cover

Decaying Tillage Radish®

How it pays: Reduces input

Tillage Radish® — the Nutrient Scavenger

TILLAGE RADISH® CAPTURES MOST AVAILABLE (N)

University of Maryland research supports up to 150 lbs of (N) per acre taken up in the fall, stored over winter and released in the spring (April-June). This particularly applies in a situation where a fall application of manure is spread.

TAPROOT SCAVENGES HIGH LEVELS OF NUTRIENTS

Tillage Radish® taproot will scavenge significant levels of nutrients (N), (P), (Ca), and many other yield-advancing nutrients with a wicking effect up to 6 feet deep, making it available for the next crop!

(N) IS AVAILABLE JUST WHEN CROPS NEEDS IT

Research shows the greatest amount of available (N) is in May-June which coincides with when cash crops need it!

RESIDUE DECOMPOSES QUICKLY, RELEASES (N) EARLY

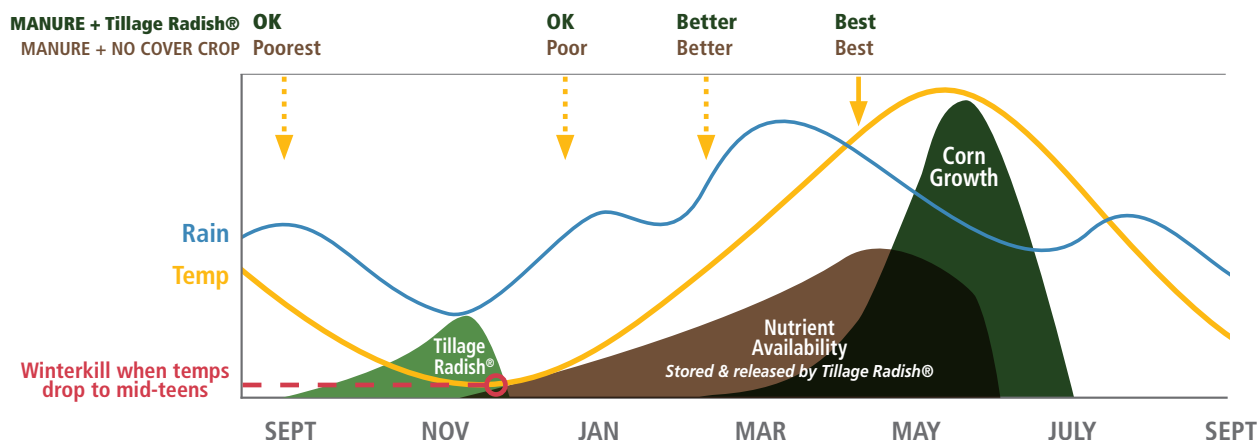
Unlike cereal rye and other cereal cover crops whose residues decompose slowly and immobilize (N) in the spring, Tillage Radish® residue decomposes rapidly and releases its (N) early.

MINERALIZATION PEAKS IN MAY-JUNE

Tillage Radish® recycles large amounts of (N) taken up from the soil profile in fall, reducing the need for (N) fertilizer. Spring-planted crops often show an early boost in growth and (N) uptake similar to that caused by a planting time (N) application.

Source: *Multiple Benefits from Brassicaceous Cover Crops & Cover Crop Mixtures: Making Cover Crops Pay in the Chesapeake Bay Region.* Submitted to the Maryland Center for Agro-Ecology, August 2007. Performance period: 7/01/03 - 4/30/07. FRS#s 01-5-25031 & 01-5-25036. Principal Investigator: Ray Weil, Professor, Dept of Environmental Science & Technology, University of Maryland. Co-Investigator: Sandra Sardanelli

Tillage Radish® & NUTRIENT APPLICATION (N) or Manure Application



How it pays: Reduces compaction

TILLAGE RADISH® RIPPER VS STEEL

The Tillage Radish® taproot does all the hard work so you don't have to. It acts as a Ripper or strip tiller, reaching subsoil without bringing up rocks, bringing up nutrients instead. It will work for you even when the soil is too wet to till. Which means not only less work for you, but less fuel consumption. Improved soil fertility is a result of Tillage Radish® storing nutrients including (N), (P), (Ca), and more, then making them available for your next crop.



Breaks up soil with its long taproot

Dr. Weil explores the root growth in a soil pit. The tuber pushes soil up making it more mellow. As bottom photo shows, no need to till soil that looks like this!

“No piece of steel can benefit the soil like the roots of a good cover crop.”

— Steve Groff, farmer & cover crop innovator

COST OF V-RIPPER PER ACRE

LinderFarmNetwork.com

2011 Farm Custom Rates

\$25.00

WHAT THIS MEANS FOR YOUR BOTTOM LINE:

Tillage Radish® gives you more than savings on the cost of using steel. The bio-drilling traits of this powerful taproot breaks up your compaction with long term benefits that add up!

- Vital nutrients held & released = higher crop yields
- Long taproot breaks up soil much deeper than a V-Ripper can
- Less work in field, less fuel used = reduced operating costs

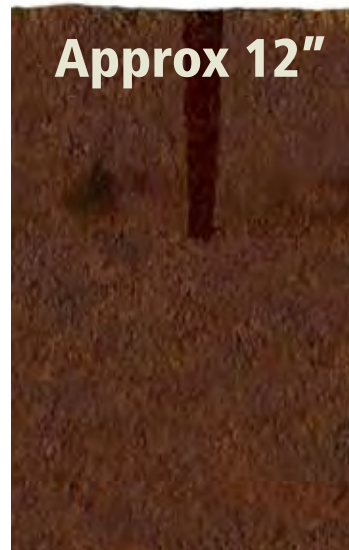
TILLAGE DEPTH COMPARISON

Tillage Radish®

Ripper

Up to 32"

Approx 12"



How it pays: Weed control

LESS WEEDS, LESS HERBICIDES

Tillage Radish® has an amazing ability to out-compete winter annual weeds. Some farmers have eliminated a spring burndown herbicide application! This is not an allopathic effect but rather that they grow faster and shade out weeds that would otherwise germinate and grow. Here's what experts and farmers alike have to say...

"A good stand of early-planted Tillage Radish® produces a dense canopy that all but eliminates weed emergence in the fall and winter. This will produce a virtually weed-free seedbed in early spring. To obtain this near-complete weed suppression, Tillage Radish® should be planted at least 3 weeks before killing frosts with a stand of 5 to 8 plants per square foot."

"Several dairy farmers in Maryland and Pennsylvania have successfully no-till planted directly onto the virtually weed-free and almost completely decomposed Tillage Radish® residue without any burndown herbicide."

Source: Weil, R., C. White and A. Kremen. 2009. Forage Radish: New Multi-Purpose Cover Crop for the Mid-Atlantic. Dept. of Agriculture, University of Maryland. Fact Sheet 824

"The Tillage Radish® has done its bio-drilling and seems to leave a "film" over the top of the ground that inhibits the spring weed flush."

— **Furmano Foods**

"There were no weeds in the Tillage Radish® plot in the spring so we didn't need a burndown herbicide."

— *Brian Hearn, University of Delaware*



Tillage Radish® in late February in Maryland. Notice weed suppression compared to no cover plot behind it (which went unweeded after late August tillage). Photo: Ray Weil

Compare the growth!

Corn is off to a faster start in Tillage Radish® residue (rows on right) than in Cereal Rye residue (row on left) due to better (N) availability and warmer soil.



*Planted into
Cereal Rye*

*Planted into
Tillage Radish®*

How it pays: Enhances seed bed

EARLIER PLANTING & GERMINATION

Unlike most other cover crops commonly used, Tillage Radish® won't complicate or delay spring field operations. Because it winterkills in most areas, it does not need to be killed or incorporated to prepare a spring seedbed. When conditions are favorable, the field will be ready for direct planting.

Because Tillage Radish® leaves the soil surface weed free, punctured by large root holes, and covered by very thin and sparse residue, the seedbed soil warms up and dries out considerably faster in early spring than do soils covered by either winter weeds or a growing cover crop. The warmer, drier soil and the elimination of the need for tillage can allow for earlier spring planting.

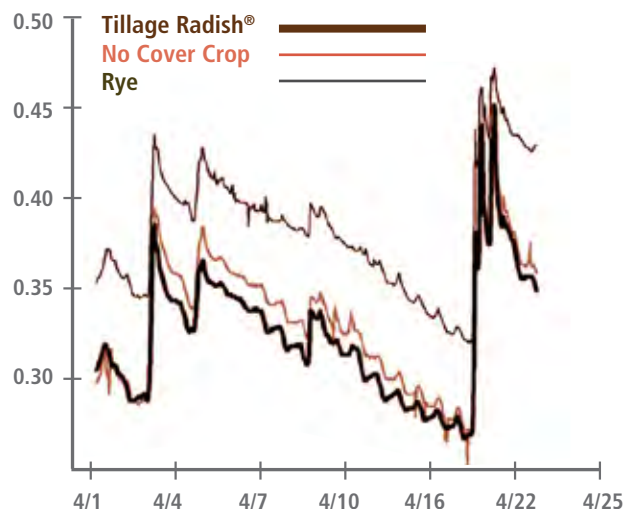


No-till planted Peas emerge in minimal spring residue of the Tillage Radish®.

Tillage Radish® soils are drier for earlier planting...

VOLUMETRIC MOISTURE CONTENT

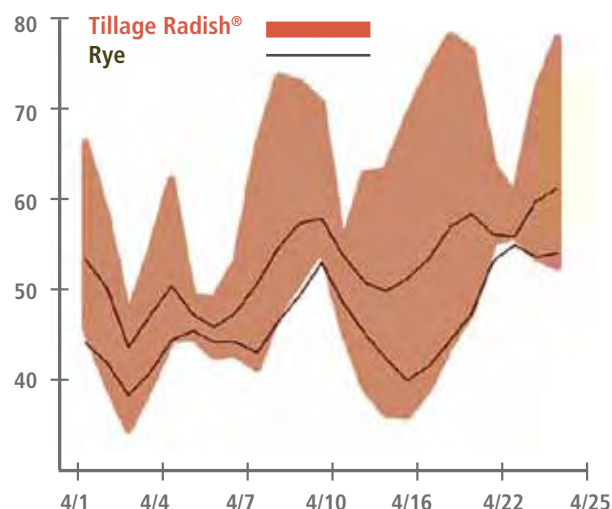
University of Maryland



Tillage Radish® soils are warmer for earlier germination...

DAILY RANGE OF SOIL TEMPS AT 2" DEPTH (°F)

University of Maryland



How it pays: May help control nematodes



Tillage Radish® helps bring the good critters while helping keep bad guys at bay, all without the use of pesticides!

Get this: earthworms love it! The deep Tillage Radish® taproot fractures and loosens your soil, creating micro pores. The result is water and oxygen effectively infiltrating the soil which works to increase organic matter and microbial activity. Tillage Radish® is a magnet to highly beneficial earthworms.



Tillage Radish® seedling 1 week after planting. Earthworms seem to love them all the time, a key indicator of good soil health.



More earthworms

(Top) There are over 30 worms in this Tillage Radish® enriched soil.

(Bottom) A close look at how much earthworms love this radish. Look at 'em go!

Tillage Radish® Genetics

Superior Genetics for Dependable, Consistent Results

The superior genetics of Tillage Radish® are the secret weapons behind the dependable, consistent results that deliver a better bottom line.

EXTREMELY RAPID GERMINATION AND GROWTH

- Germinates in 2 to 3 days if adequate moisture is available
- Foliage spreads out to fill the given space and shade out weeds
- The tuber and thick foliage are the storehouse for nutrients
- Grows to a height of 12-24" depending on when it was planted

BIOACTIVE PLANT CHEMICALS (GLUCOSINOLATES)

- Studies show Tillage Radish® increases the soil's bacteriovores who feed on nematodes and increases the (N) cycling process mineralizing available (N), (P), (Ca) and (S)
- Weed-suppressive effect that helps shade out competition
- High levels of the compound glucosinolate, when decomposed, produces isothiocyanate (ITC) which has fungicidal, nematicidal properties. Some studies say it can also help inhibit weed seed germination

LARGE, DEEPLY PENETRATING TAPROOT

- Pulls up nutrients, allows increased water infiltration, establishes a root trail for the next crop, stores water in the soil profile
- The Tillage Radish® bio-drilling taproot forms when soil compaction reaches around 290 psi, boring into the subsoil to wick up nutrients

- Taproot has been reported to go 30 inches and beyond

WINTERKILLS & QUICKLY DECOMPOSING RESIDUES

- Usually after three nights with temperatures in the mid-teens
- Residue is very sparse at planting time
- Low (C)/(N) ratio making for a fast mineralization
- Releases stored nutrients at the time the next crop needs it (April-June)

HIGH NUTRIENT (N, P, Ca, S, B) CONTENT

- A nutrient scavenger taking up nutrients throughout the soil profile
- A Calcium film is left on the soil surface as part of decomposition
- Sulfur is concentrated in the roots and gives off an odor when decomposing, just like the additive mercaptan that is added to natural gas. As a warning, you may want to inform neighbors to the possibility of this odor. You do not want the gas company digging up your fields
- Tillage Radish® mineralizes available (N), (P), (Ca) and (S)
- Tillage Radish® pulls up twice the amount of (Ca) than cereal rye

Source: Forage Radish Cover Crop Effects on Mycorrhizal Colonization & Phosphorus Soil Test. Charles Macaulay White, Master of Science, 2009.

Grazing Tillage Radish®

Many farmers with livestock* have used Tillage Radish® as part of their grazing program. It is preferred that a companion forage crop, such as TillageMax Dover™ (Tillage Radish® + CCS Oats) or TillageMax Bristol™ (Tillage Radish® + Tillage RootMax™ Deep Root Annual Ryegrass™), be included to better balance the ration. It is important to understand the dynamics of the 2 main reasons for using Tillage Radish® in a grazing situation: forage for cattle and compaction alleviation.

Careful management is needed to not allow the cattle to graze in very wet conditions as that will negate the compaction benefits Tillage Radish® has to offer. Also, the cattle cannot be allowed to graze the Tillage Radish® to the point where they can't express their genetic potential of deep rooting (if that aspect is desired).

Tillage Radish® has been proven to bring up many nutrients from deep in the soil profile that can greatly benefit the cattle's diet.

**Not recommended for lactating dairy cows.*



PLANTING TIPS FOR GRAZING

- Always mix a grass species with Tillage Radish® planted at 4 lbs/acre
- Provides a high protein diet into early winter
- Allow the cattle to only graze off the top one-third in order for adequate re-growth

PLANTING TIPS FOR ESTABLISHED PASTURES

Tillage Radish® seed needs a chance to get started in pastures, and it's ideal to have the grass grazed low or cut low with adequate moisture prior to planting. Have the soil (N) content at least between 40-60 lbs.

Seeding rate is 4 lbs/acre drilled. Broadcasting will only work if there is adequate seed to soil contact - use 6 lbs/acre.

The radish is very digestible and provides many nutrients. Having other species established provides a balanced diet.

- Plant Tillage Radish® at 4 lbs/acre when direct drilling into pastureland
- Plant Tillage Radish® at 6 lbs/acre when broadcast seeding into pastureland
- Follow soil test recommendations
- Nitrogen available between 40-60 lbs
- Allow 3-4 weeks growth time before grazing
- Re-graze approximately on a monthly interval
- Graze no lower than 4" if you desire multiple grazing
- For best palatability, graze before it flowers

Planting Tips

You will have success with Tillage Radish® wherever agricultural crops are grown. pH range 5.5-7.5



TIPS FOR SUCCESSFUL TILLAGE RADISH® PLANTING

- For best results, plant in late summer to early fall, at least 3 weeks (typically 30-60 days) prior to the average first killing frost date.
- Green growth starts in less than 1 week in normal conditions. The size of the Tillage Radish® depends on soil fertility, length of growth time, plant competition and available nutrients to scavenge.
- Tillage Radish® will germinate rapidly and typically start appearing within days. If using a burndown herbicide to clean up existing weeds, wait no longer than 2 days after planting Tillage Radish®.
- Tillage Radish® begins to winterkill when temperatures fall to the mid-teens for 2 or 3 nights, similar to fall-planted spring oats.
- In most areas, Tillage Radish® will decompose in time for spring planting, preparing the field for planting conditions and enhancing the availability of nutrients already in your soil.
- Tillage Radish® is a broad leaf plant. Consider this when planning your herbicide program.
- Fertilizer input needs are significantly reduced; available leftover (N) has been held and herbicide is reduced due to Tillage Radish® suppression of winter annuals.

NITROGEN

In order to grow to their fullest potential they will need 40-60 lbs of (N) – accumulated or residual. Most fields have enough (N) left over from the previous crop. Upon decomposition in the spring, Tillage Radish® will give (N) back in time to utilize in the spring crop.

Applying manure or chicken litter is preferred before planting but can be done just prior to emergence. Liquid manure can only be spread after plant leaves are 4" in size. The practice may cause some burning of the leaves and will have plant damage along tire tracks.

The Tillage Radish® tuber and foliage will take up to 150 lbs/acre of (N) from the manure, so it is a great benefit to store nutrients when there is a need to spread manure after crop harvesting in the fall.

PLANTING DEPTH

Plant 1/4 to 1/2 inch deep. Can be planted 1" in light soils if necessary to reach moisture

SEEDING RATES (Tillage Radish® Planted Alone)

Precision Planter - 4 lbs/acre

- 15" rows using 60-cell small milo or small sugar beet plates with 4" in-row spacing
- Seed is selected for Precision Planting performance. Seeds per lb are located on seed bag label

Drill Seeder - 6 lbs/acre

- Using small grass box, use alfalfa setting as a guide to set seeding rate. A large seed box can be used but the setting is very low and somewhat difficult to establish. Use Alfalfa as comparable seed on drill charts, reducing by 10%. It's important to calibrate your drill to determine correct seeding rate

Broadcasting/Aerial Seeding - 8-10 lbs/acre

- Strive for good soil and moisture contact. If fields are moist, fly seeds on. If fields are dry, push seeds in
- Corn seeding indicator is when 1" patches of sunlight on soil surface are seen or approximately 4 weeks prior to anticipated harvest time
- Soybean seeding indicator is at leaf yellowing
- Cotton seeding indicator is right before defoliation
- Improve success rate by using drop tubes when seeding with a high clearance cover crop seeder

CONTROL

Tillage Radish® winterkills with 3 nights in the mid-teens.

If Tillage Radish® is planted very early as a cover crop, flowering can develop before they are winterkilled. This can be controlled with mowing, grazing or burndown of one quart of glyphosate along with one pint of 2,4-D equivalent at flowering.

Precision Planting

GET THE BEST PRECISION PLANTING PERFORMANCE

Save in seed cost... Precision Planting can reduce seeding rates of Tillage Radish® by half!

For precision planting, use a small sugar beet seed disk to plant Tillage Radish® and set to plant 4" in-row spacing. Utilizing a precision planter set up for 15" rows is ideal and many farmers plant Tillage Radish® in alternating rows with CCS Winter Pea. A standard soybean disk can be used at the same 4" in-row spacing on alternating rows using CCS Winter Pea.

Also, some farmers who have 30" planters will equip one side of the planter to plant Tillage Radish® and the other side to plant CCS Winter Pea. They then double back and split the rows creating an alternating row effect.

With a precision planter set to plant at a 4" in-row spacing approximately 4 lbs/acre of Tillage Radish® is the

resulting seeding rate in 15" rows. If alternating every other row with peas, the approximate seeding rate is 2 lbs/acre of Tillage Radish® and 13 lbs/acre of CCS Winter Pea.

RECOMMENDED SEED DISCS

John Deere Pro or MaxEmerge Vacuum – A51712
(Increase speed by 35%)

Kinze Edge Vac – D17050

Kinze Brush Meter – GA5795

White – 854047

Case/IH 1200 series – 236027A2
(Old Milo Drums improve population)

Precision Planting (eSet disc) – 720220
(Run vacuum at 15")

Monosem – 6020

PRECISION PLANTING EXAMPLES



Precision Planted with wheat using a Kinze 60-cell Small Milo plate with 4" spacing in-row



Tillage Radish® 2 lbs/acre Precision Planted with CCS Winter Pea (13 lbs/acre; 60-cell soybean plates) with a 15" White Planter using 60-cell sugar beet plates at 4" in-row spacing



TillageMax MIXES

Exceptional Cover Crop Mixes

Featuring Tillage Radish®

KEY BENEFITS

- Increases yields and profits
- Improves soil health & fertility
- Scavenges nutrients, esp. nitrogen
- Reduces soil compaction
- Suppresses weed growth
- Enhances seed bed
- Reduces input
- May control nematodes

The new TillageMax Mixes is a line of high performance cover crop and forage mixes only from Cover Crop Solutions. Each mix delivers the benefits of Tillage Radish® with the superior characteristics of Tillage RootMax™ Deep Root Annual Ryegrass™, CCS Crimson Clover, and more.



TillageMax INDY™

Tillage Radish® + Tillage RootMax™
+ CCS Crimson Clover Mix

This 3-way mix provides a combination of deep soil tillage and yield improvements achieved by the Tillage Radish® taproot and Tillage RootMax™ Deep Root Annual Ryegrass™ fibrous roots, along with the nitrogen fixing advantages of CCS Crimson Clover.

An excellent option for getting more out of your cover crop program, this high performance mix scavenges, produces and releases (N) when crops need it most while providing other soil health building benefits.



**Tillage
Radish®**



**Tillage RootMax™
Deep Root Annual Ryegrass™**



**CCS Crimson
Clover**

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 0.25 - 1"

Comparable seed on Drill chart is Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%), Annual Ryegrass

Seeding Rate:

- **Drilling:** 15 lbs/acre
- **Broadcast / Aerial:** 17-20 lbs/acre
- **Precision Planting (15" with 2" spacing):** 12 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

Control: Tillage Radish® winterkills with 3 nights in the mid-teens. Tillage RootMax™ and CCS Crimson Clover require a burndown of two quarts of glyphosate with one pint of 2,4-D. Best control is achieved spraying on a warm day between 9 am - 4 pm with water adjusted to 5.5 ph. Visit the RootMax™ control page (pg 28) for more tips and information.



TillageMax DAYTONA™

Tillage Radish® + CCS Crimson Clover Mix

Tillage Radish® is the only proven yield-boosting cover crop radish, and absorbs soil nitrogen and other key nutrients with its unique taproot that grows 30" and deeper.

CCS Crimson Clover converts atmospheric nitrogen into plant available nitrogen, helping reduce fertilizer input while improving soil health by adding organic matter. Maximum nitrogen is achieved at first flower of CCS Crimson Clover. This is a high performance cover crop mix.

**Tillage
Radish®**



**CCS Crimson
Clover**

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 0.25 - 1"

Comparable seed on Drill chart is Alfalfa. Small seed box can be used

Seeding Rate:

- **Drilling:** 10 lbs/acre
- **Broadcast / Aerial:** 13-15 lbs/acre
- **Precision Planting (15" with 1.5" spacing):** 8 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

Control: Tillage Radish® winterkills with 3 nights in the mid-teens. CCS Crimson Clover can be controlled by a spring burndown with one pint of 2,4-D type herbicide along with one quart glyphosate.



TillageMax INDY™ Mix



TillageMax DAYTONA™ Mix



TillageMax BRISTOL™ Mix



TillageMax DOVER™ Mix



Tillage Radish® breaks up soil compaction with its aggressive taproot, creating thick channels 30" or deeper. This unique nitrogen storage tank holds N and other nutrients over winter and releases them as needed by following cash crops.

Tillage RootMax™ Deep Root Annual Ryegrass™ builds soil structure deeper than many other ARG varieties. In combination, this outstanding cover crop mixture provides added cover in the spring prior to burndown.

Tillage Radish®



Tillage RootMax™ Deep Root Annual Ryegrass™

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 0.25 - 1"

Comparable seed on Drill chart is Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%), Annual Ryegrass

Seeding Rate:

- **Drilling:** 12 lbs/acre
- **Broadcast / Aerial:** 15-17 lbs/acre
- **Precision Planting (15" with 1.75" spacing):** 10 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

Control: Tillage Radish® winterkills with 3 nights in the mid-teens. If it does not winterkill, add one pint of 2,4-D type herbicide. Tillage RootMax™ requires a burndown of two quarts of glyphosate. Best control is achieved spraying on a warm day between 9am - 4pm with water adjusted to 5.5 ph. Visit the RootMax™ control page (pg 28) for more tips and information.



Both excellent scavengers of N, this Tillage Radish® and CCS Oats mix will grow rapidly in cool weather and is ideal for quick fall cover.

Tillage Radish® breaks up soil, even in the compaction zone, with its long, singular taproot to create thick channels 30" or deeper. This mix enhances seedbeds, provides more ground cover in spring, helps control erosion, works to help control harmful nematodes, and will winterkill for easy spring management.

Tillage Radish®



CCS Oats

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 0.5 - 1"

Comparable seed on Drill chart is Oats

Seeding Rate:

- **Drilling:** 25 lbs/acre
- **Broadcast / Aerial:** 30-45 lbs/acre
- **Precision Planting (15" with 5" spacing):** 20 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)

Control: Winterkills after 3 nights in the mid-teens. If Tillage Radish® or CCS Oats does not winterkill, apply a combination of one pint of 2,4-D type herbicide along with one quart of glyphosate at flowering or heading.



TillageMax CHARLOTTE™

Tillage Radish® + CCS Fridge Triticale + CCS Crimson Clover Mix

This cover crop mix offers Tillage Radish® for breaking up soil compaction with its aggressive taproot, creating thick channels 30" or deeper. This unique nitrogen storage tank holds N and other nutrients over winter and releases them as needed for following cash crops.

CCS Fridge Triticale soaks up additional N in the fall as well as in the spring, keeping any N from leaching until a cash crop can utilize it. CCS Crimson Clover adds up to 50 lbs of additional N in the spring.



Tillage
Radish®



CCS Fridge Triticale



CCS Crimson
Clover

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 1"
Comparable seed on Drill chart is Wheat

Seeding Rate:

- **Drilling:** 40 lbs/acre
- **Broadcast / Aerial:** 50 lbs/acre
- **Precision Planting (15" with 5" spacing):** 30 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)

Control: It is recommended to control when CCS Fridge Triticale reaches 18" in height. Use one quart of glyphosate and one pint of a 2,4-D product which will control CCS Fridge Triticale, CCS Crimson Clover and any Tillage Radish® that may not have been winterkilled.



TillageMax HOMESTEAD™

Tillage Radish® + Tillage Sunn™ + CCS Pearl Millet Mix

A true soil builder, HOMESTEAD helps restore soil health following challenging conditions like extended drought or flood. Tillage Sunn™ is a tropical warm weather legume that thrives in dry conditions and poor soil, and suppresses nematodes. It can produce over 60 lbs of N in 6 weeks! CCS Pearl Millet adds plenty of biomass both in above ground and with its roots.

Tillage Radish® is shaded by the two taller species during the summer and then springs to life at the first sign of cooler weather, soaking up massive amounts of N the Tillage Sunn™ produced and storing it for when the newly planted spring cash crop needs it most. Ideal for planting during the summer after small grains, prevent planting acres, or early harvested vegetable crops.



Tillage
Radish®



Tillage Sunn™



CCS Pearl
Millet

Planting: Late spring to 8 weeks before the first frost

Seeding Depth: 1"
Comparable seed on Drill chart is Wheat

Seeding Rate:

- **Drilling:** 15 lbs/acre
- **Broadcast / Aerial:** Not recommended
- **Precision Planting (15" with 2" spacing):** 12 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

Control: Tillage Sunn™ and CCS Pearl Millet kill with the first frost. Tillage Radish® is winter killed with a few nights in the mid-teens. A quart of glyphosate and one pint of a 2,4-D product will control any Tillage Radish® that may not have been winter killed.



This high-performance mix achieves a bundle of benefits, starting with the amazing Tillage Radish® taproot that drills right through tough compaction. The winter hardy CCS Fridge Triticale excels at soaking up any left over N from a previous crops or manure application. Can be used as a forage in the spring by doubling the seeding rates.

This is the mix you need where it is certain there is plenty of N or you have nutrients in manure you want to catch in the fall and release in the spring.

Tillage Radish®



CCS Fridge Triticale

Planting: Plant 3-10 weeks prior to first killing frost

Seeding Depth: 1"
Comparable seed on Drill chart is Wheat

Seeding Rate:

- **Drilling:** 40 lbs/acre
- **Broadcast / Aerial:** 50 lbs/acre
- **Precision Planting (15" with 5" spacing):** 30 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)

Control: It is recommended to control when CCS Fridge Triticale reaches 18" in height. Use one quart of glyphosate and one pint of a 2,4-D product which will control any Tillage Radish® that may not have been winterkilled.



Learn more about TillageMax Mixes
featuring Tillage Radish® at:

TillageRadish.com



Scan code for additional
planting information



Tillage RootMax™ is a different kind of annual ryegrass. It's been developed and tested as a superior annual ryegrass (ARG) for cover crop and forage applications. Here are some of the differences you'll see with certified Tillage RootMax™ Deep Root Annual Ryegrass™.

1 Certified uniformity



Tillage RootMax™ has outstanding uniformity at emergence and throughout growth and maturity, which makes it different than other annual ryegrass varieties. In the spring Tillage RootMax™ has significantly more top leaf tiller growth than other ARG varieties. Plant energy is designed to be directed to the roots, resulting in a much deeper root zone.

2 Easier control

Where some ARG varieties cause problems in the spring by irregular growth and early heading out, requiring more than one control treatment, Tillage RootMax™ is much more suited to farming practices where efficiency and productivity are critical. The easier control that Tillage RootMax™ provides is based on a combination of shorter and more desired dense leaf tillering, uniform growth, and preferred later maturity.

The common control is applying one quart of glyphosate before jointing in spring. Best burndown is achieved spraying on a warm day between 9 am - 4 pm with water adjusted to 5.5 ph.

3 Deeper root mass, better soil structure

The fine root mass of Tillage RootMax™ grow especially deep to build soil structure through the addition of organic matter, opening of macro pore spaces, introduction of air and water to deeper layers in the soil profile, enhanced soil biological activity, increased water infiltration and water holding capacity after control, and better soil particle aggregation. It all adds up to healthier soil that supports crop growth while reducing input requirements.

4 Later maturity – a certified advantage

- Compared to other ARG varieties, Tillage RootMax™ is easier to control in the spring.
- You have at least three more weeks of denser tiller leaf growth.

Visit our dedicated website: RootMax.com

The only certified annual ryegrass developed especially for cover crops and superior forage quality

- You have three more weeks to burn down Tillage RootMax™ than other varieties.
- The preferred late 'heading out' is a big help when fields are wet in the spring and conditions require greater flexibility for the herbicide application.

5 Excellent nitrogen (N) scavenging

This is why most farmers look to annual ryegrass (ARG) to plant over winter to keep the soil covered, help improve soil structure, and store significant amounts of nutrients in addition to N.

What makes Tillage RootMax™ different is its noticeably deeper roots. That means it grows deeper in to the soil to extract and hold nutrients. At termination before row crops are planted, these nutrients are plant available, helping reduce input requirements.

6 Reduced soil loss

Soil erosion conditions are minimized when fields are effectively planted with Tillage RootMax™ as a cover crop, eliminating exposed soil that would otherwise become crusted and "sealed" when rain drops cause surface compaction on bare soil. Tillage RootMax™ also encourages water to infiltrate the soil profile instead of washing downstream. This cover also prevents wind blown particles from forming dust clouds.

7 Water management

Tillage RootMax™ planted as a cover crop is a simple way to improve water infiltration as a potential hedge against drought. Its dense top growth protects the soil from rain drop compaction, the exceptionally deep roots provide channels for water to infiltrate deeper than ever, and when terminated, the loosened channels left in the soil by its roots let cash crop roots grow deeper to get that stored moisture. Think of RootMax™ as a deeper, denser, underground moisture reservoir.

8 Research is showing other benefits

Current research on Tillage RootMax™ shows a significant reduction in soybean cyst nematode populations. Other research includes forage trials and winter hardiness. Meanwhile, Tillage RootMax™ has already set new standards by providing the needed benefits when planted as a cover crop and added value to your cover crop mixes.

KEY BENEFITS

- Certified genetic purity
- Uniform stand maturity for easier burndown
- Very deep soil-building roots
- Late heading out, longer spring window
- Winter hardy
- Unique morphology
- High vegetative tillering
- Outstanding nutritional value
- Breaks up hardpan & compaction
- Scavenges nutrients, esp. nitrogen
- Speeds up transition to continuous no-till
- Increases crop yields and profits

GENETIC
Certified
PURITY

Tillage RootMax
MORE TILLERS
DEEPER ROOTMASS



Deep Root Technology: Now Available After 13 Years in Development

Tillage RootMax™ Deep Root Annual Ryegrass™ is the only variety certified for genetic purity for use as a cover crop and forage. The certified genetic purity assures maximum performance of unique properties of this new annual ryegrass, including:

- Uniform emergence leads to more even growth
- Even growth makes for easier control in the spring; one trip in most cases
- Roots go deeper than most other annual ryegrass varieties
- Improved soil structure goes deeper in the soil profile, providing enhanced growing conditions for following cash crops
- Outstanding nutritional value for forage
- Excellent for grazing or haylage production

PLANTING TIPS & SEEDING RATE

Planting: Plant 3-10 weeks prior to the first killing frost

Seeding Depth: 3/8 - 0.5"

Comparable seed on Drill chart is Tall Fescue (reduce by 20%), Crested Wheat Grass (reduce by 10%), Annual Ryegrass

Seeding Rate:

- **Cover Crop by Drill (7.5" rows):** 12 lbs/acre
- **Broadcast / Aerial Seeding:** 15-18 lbs/acre
- **Forage by Drill or Broadcast:** 18-30 lbs/acre
- **Precision Planting (15" with 1.5" in-row):** 10 lbs/acre
(Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

Control: Applying two quarts of glyphosate before jointing in spring. Best burndown is achieved by spraying on a warm day between 9 am - 4 pm with water adjusted to 5.5 ph.

Visit RootMax.com and the RootMax™ control page (pg 28) for more helpful control tips and information.



Scan code
for additional
planting
information

Burndown & Control of Tillage RootMax™ Deep Root Annual Ryegrass™

THE PLANT

- ☐ Control Annual Ryegrass before the first node appears when possible.



First node / joint

Control is most effective before the first node/joint appears. Once the third node/joint appears control is poor because of limited translocation, as active growth in the plant goes to reproduction.



UNCERTIFIED CERTIFIED

Uncertified Annual Ryegrass seed may grow at different rates, which makes control more difficult because of uneven maturity. Certified seed grows at a uniform rate, which makes control with a single application easier to achieve.

THE CHEMISTRY

- ☐ Remove all traces of atrazine or mesotrione (Calisto,* Lumax, Lexar) in the spray tank when using glyphosate.
- ☐ Glyphosate recommendations are now 2 qts per acre.
- ☐ Inconsistent control has been experienced using Accent (nicosulfuron) or Steadfast post emergence on corn. Follow the label even with adding fertilizer, AMS and crop oil to improve herbicide absorption efficiency.
- ☐ Glyphosate works effectively alone or with 2,4-D. **MAINTAIN** the 2 qt. rate of glyphosate **IF** adding Princep, Balance Pro (isoxaflutole), Prowl H2O (pendimethalin), Resolve (rimsulfuron), Basis (rimsulfuron & thifensulfuron), Corvus (Thiencarbazone-methyl & Isoxaflutole) or Axiom (flufenecet + metribuzin) to the glyphosate application.

TECHNIQUE

- ☐ Do not repeat mistakes that may have happened on the first application.
- ☐ Make sure the spray tank water is between 4.5 to 5.5 pH. Make sure to add AMS (ammonium sulfate) or citric acid, with 3-5 minutes of agitation for pH adjustment. This step is critical when water is high in calcium, magnesium, iron and other minerals that interfere with glyphosate activity. Agitation of the mixture is cheap insurance.
- ☐ Don't pull your punches. Use the full strength of the suggested control rate. The goal is complete control on the first pass.
- ☐ If you use a generic brand of control, make sure to adjust the rate.
- ☐ Plant contact is critical. Use a medium spray droplet size or moderate spray pressure. Spray application volume should be 8 to 12 gallons per acre, so spray strength is important.

TIMING

- ☐ Warm temperatures are essential to translocate glyphosate throughout the plant so that it is absorbed into the roots for control.

CONTROL IS BEST WHEN THE PLANT IS ACTIVELY GROWING (HIGH TRANSLOCATION)

Key trigger points to consider when controlling with glyphosate.

1. Top Growth should be more than 7 inches
2. Sunlight – the more the better
3. Soil Temperatures – above 45 degrees F
4. Air Temperatures – above 60 degrees F
5. Moisture – growing conditions should be good

If night temperatures go below 38 degrees wait 3 days before spraying.

This is due to a protection mechanism by the plant to prevent freezing tissue.

- ☐ Spray at least 4-5 hours prior to sunset to allow translocation time.
- ☐ If a second pass is needed, there should be a minimum of three weeks after the first control application. The regrowth and retillering will allow for more herbicide to get to the roots for final control.

FOR ROUNDUP READY CORN OR SOYBEANS

When planting Roundup Ready corn or soybeans after emergence use a full rate of glyphosate – up to 2 quarts per acre.

On Roundup Ready soybeans you can add SelectMax (clethodim), Poast Plus (sethoxydim) or Fusilade DX (fluazifop), using label instructions on the use of fertilizer, AMS or crop oil.

FOR LIBERTY LINK CORN OR SOYBEANS AFTER EMERGENCE

CORN Liberty does not control annual ryegrass very well. Products with Accent (nicosulfuron) have been inconsistent. Use label recommendations of adding fertilizer, AMS or crop oil to improve performance.

SOYBEANS Add SelectMax (clethodim), Poast Plus (sethoxydim) or Fusilade DX (fluazifop), using instructions from the Liberty/Ignite label for any needed additives.

FOLLOW THROUGH

- ☐ Inspect fields 7-10 days after control application. Be alert for regrowth or missed areas that need further control.
- ☐ The following year, scout these areas for volunteer ARG.

COVER CROP TIP

Select cover crop seed like you select cash crop seed – for bottom line results.

RootMax™ Deep Root Annual Ryegrass™ is certified, producing uniform emergence and exceptionally deep roots. Properly managed, RootMax™ improves soil health leading to improved crop yields and reduced input.

Photos courtesy of Grant Heilman Photography, Lititz, PA

SOURCES: Annual Ryegrass Cover Crop Management for Corn and Soybean Production 2012; management recommendations by Mike Plumer, Cover Crop Specialist; Mark Melbye, OSU Ext. Agronomist; Andy Hulting, OSU Ext. Weed Management Specialist

* Herbicide brands mentioned here are recognized as the property of their respective manufacturers.

Forage Production Using Tillage RootMax™ Deep Root Annual Ryegrass™

TIME OF APPLICATION

Annual Ryegrass is one of the highest quality cool-season grasses available. When planted in the early fall (August or the first week in September), it can be grazed or cut for haylage in the fall and possibly in the spring. Using Annual Ryegrass leads to healthier livestock production, at a lower cost, compared to stored forage. In the leafy stage it is highly digestible and is preferred by grazing animals over other forages. Annual Ryegrass is also high in protein and contains significant amounts of vitamins and minerals. Annual Ryegrass harvested before the joint stage (with sufficient N applied) can have protein levels from 20-28 percent. After jointing, protein level will decrease as the amount of biomass increases.

SEEDING DETAILS

Follow general recommendations for using Annual Ryegrass as a cover crop. However, make the following adjustments:

SEEDING DATE – THE EARLIER THE BETTER

- Seeding in August or early September is critical if you expect fall forage.
- Seeding after wheat, vegetables or corn silage, with manure applied, provides an excellent opportunity to produce some very high quality forage.
- A later seeding in late September may allow early spring grazing or greenchop.
- A dormant seeding in late November/December (soil temperature less than 40° F) may provide late spring forage (too late for corn, leaving soybeans the preferred crop to no-till).

SEEDING RATE – HIGHER SEEDING RATE NEEDED COMPARED TO ARG AS A COVER CROP

- 18-30 lbs/ac drill and broadcast.

NITROGEN – A MUST

- Annual Ryegrass is a nitrogen scavenger but needs an adequate amount of nitrogen in order to produce high quality forage.
- Planting Annual Ryegrass after manure has been applied is ideal.
- Apply 40-50 lbs/ac of nitrogen (DAP, urea, ammonia sulfate, etc.) before planting, if manure is not applied.
- If forage is harvested in the fall and spring forage is desired, then apply another 40-50 lbs/ac of nitrogen or manure in early spring.
- Do not apply manure to Annual Ryegrass seedlings as it may be smothered or burned by the manure's salts.

HARVEST MANAGEMENT

- Annual Ryegrass can be harvested for haylage, green chop, or it can be grazed. Two to six tons/ac can be expected, depending on seeding date, fertility and weather conditions.
- It does not present endophyte fungus problems as do some tall fescues.
- For optimum yield and haylage quality (TDN, protein content, digestibility, etc.) cut the Annual Ryegrass when the plant is between the boot and early head stage.
- For grazing and greenchop, start when the Annual Ryegrass is 8-10 inches tall. Light grazing when Annual Ryegrass is 4-5 inches tall (60 days after planting).
- If regrowth is desired, graze or chop it no lower than three inches.
- If ungrazed, or undergrazed Annual Ryegrass can grow to seed head stage too quickly, resulting in lower quality and lower overall production.
- Good dry hay usually takes an extra day or two of drying time along with aggressive tedding of the swath as Annual Ryegrass has a waxy leaf coat and it makes a dense swath that is difficult to get air through, thus slowing the drying process.

If Annual Ryegrass vegetation is removed, then little, if any, nitrogen can be expected for the following corn crop.

2012 Cover Crop Research

Early Season Corn Hybrids & Earlier Cover Crop Planting

Steve Groff Farm-Scale Cover Crop Research Results ■ Conducted at Cedar Meadow Farms, Holtwood, PA, by Steve Groff and staff

Research background and notes

Short Season Corn Yield Research Results

- Fields were planted between April 16th and April 25th. Each direct comparison (field) was planted the same day.
- Each yield data point represents 3 replications of 4-30" rows 500 to 1,000 feet in length. Plant population at planting was 32,000 seeds per acre for each hybrid.
- Each field was fertilized according to need.
- Field moisture was adequate until the middle of June when it turned dry for 5 weeks. Then from the middle of July through harvest, moisture was adequate.
- All bushels are dry bushels. Each hybrid was harvested at optimal maturity between Sept 9 and Oct 1, targeting moisture around 21%.
- Research was conducted at Cedar Meadow Farm, in Southeastern PA. - USDA Plant Hardiness Zone 6B.

Field #	Shorter Season	YIELD	Mid Season	YIELD	Longer Season	YIELD	Avg. Yield in field
Field 1	83 day	207.41	95 day	212.12	107 day	178.47	199.33
Field 2	89 day	164.81	102 day	153.45	110 day	177.93	165.39
Field 3	92 day	155.74	102 day	144.25	111 day	158.07	152.69
Field 5	97 day	195.24	108 day	164.71	111 day	189.55	183.17
Avg. Yield by Maturity		180.79		168.63		176.01	
Bu. Difference vs Longer Season Hybrid		+ 4.78		- 7.38			

Total Gross Value on Harvest Day

Local price of corn was \$8.40 at first harvest date of Sept 10th and dropped to \$7.78 the last harvest date of Oct 1st.

Field #	Shorter Season	YIELD	Mid Season	YIELD	Longer Season	YIELD
Field 1	83 day	\$1,742.16	95 day	\$1,781.64	107 day	\$1,388.73
Field 2	89 day	\$1,321.70	102 day	\$1,231.07	110 day	\$1,384.06
Field 3	92 day	\$1,248.71	102 day	\$1,157.29	111 day	\$1,230.02
Field 5	97 day	\$1,606.50	108 day	\$1,281.37	111 day	\$1,475.09
Profit by Maturity		\$1,479.77		\$1,362.84		\$1,369.48
Difference in Gross Profit vs Longer Season Maturity		+ \$110.29				

Summary

- All costs associated with trial are the same for each replication except the cost of the seed, which does not necessarily correspond to each maturity and varies little.
- After each plot was harvested, a cover crop was planted within 1-3 days. In 2013, a single hybrid will be planted in each field.
- The previous replications will be used again to determine if the earlier established cover crop will effect the succeeding corn crop yield.
- 2011 results showed a 32 bu advantage of a replicated trial of a 103 day hybrid vs a 111 day hybrid.

2012 Cover Crop Research

Early Season Corn Hybrids & Earlier Cover Crop Planting

Steve Groff Farm-Scale Cover Crop Research Results

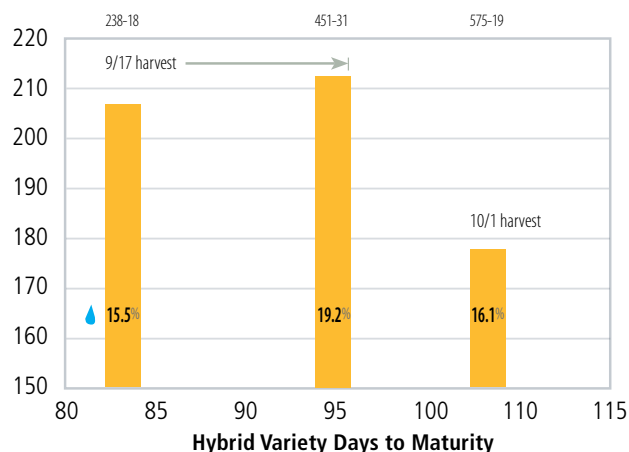
Conducted at Cedar Meadow Farms, Holtwood, PA, by Steve Groff and staff

- Background: Cover crops provide more benefit, including building soil health, if they are planted earlier in the fall, immediately following corn harvest.
- The research objective was to determine if it is possible to allow earlier planting of cover crops following corn by the use of certain short season corn hybrids.
- Research was conducted at Cedar Meadow Farm, in Southeastern PA.
- Trials used only hybrid corn varieties (reference # above each bar) from T. A. Seeds.
- Each plot included three (3) separate replications; results are averaged.

Field 1 Planted April 23 Yield data is dry bushels (15.5% moisture)

Moisture content at harvest

YIELD

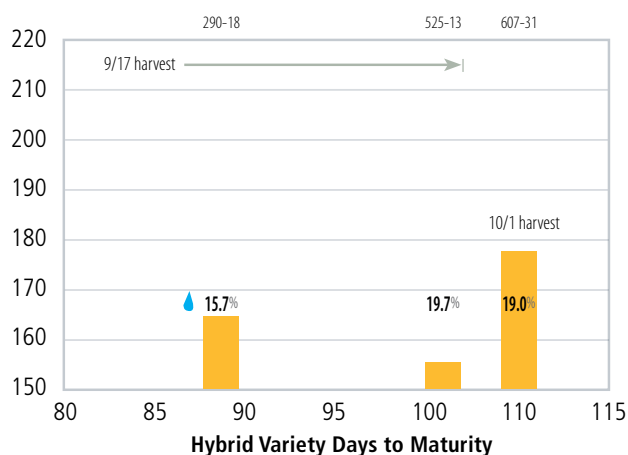


Field 2 Planted April 23

Yield data is dry bushels (15.5% moisture)

Moisture content at harvest

YIELD

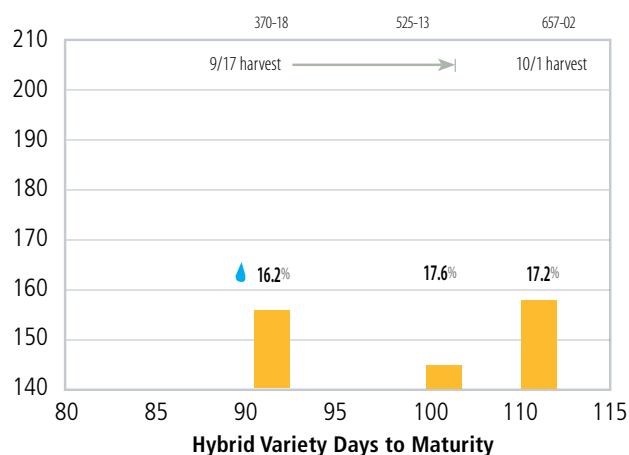


Field 3 Planted April 23

Yield data is dry bushels (15.5% moisture)

Moisture content at harvest

YIELD

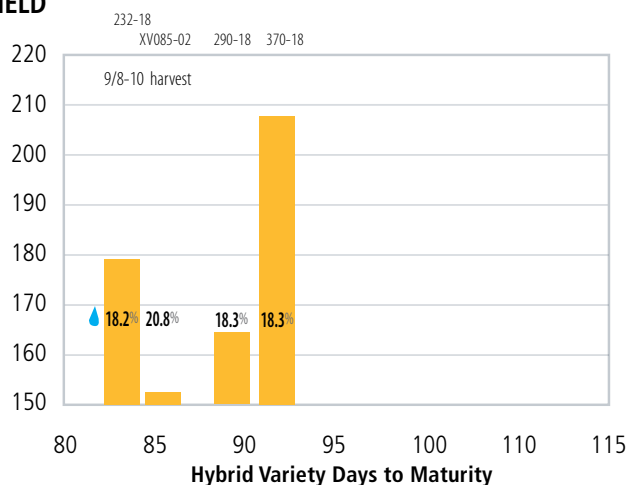


Field 4 Planted April 17

Yield data is dry bushels (15.5% moisture)

Moisture content at harvest

YIELD

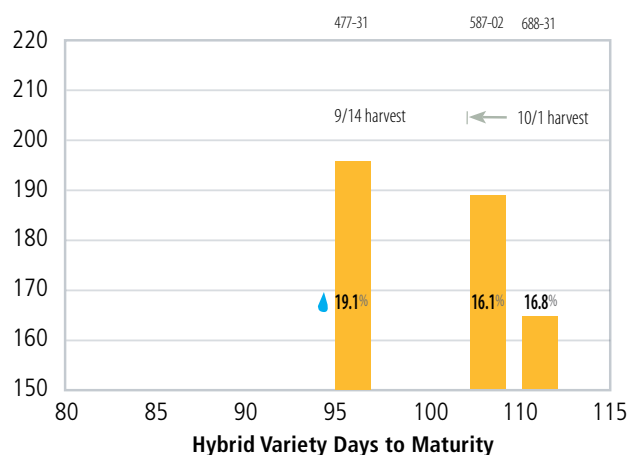


Field 5 Planted April 19

Yield data is dry bushels (15.5% moisture)

Moisture content at harvest

YIELD



2010-2011 Cover Crop Research

Tillage Radish® and Timing

Steve Groff Farm-Scale Cover Crop Research Results ■ Conducted at Cedar Meadow Farms, Holtwood, PA, by Steve Groff and staff

Research on Timing of Tillage Radish® Planting and Effect on Corn Yield

Objective:

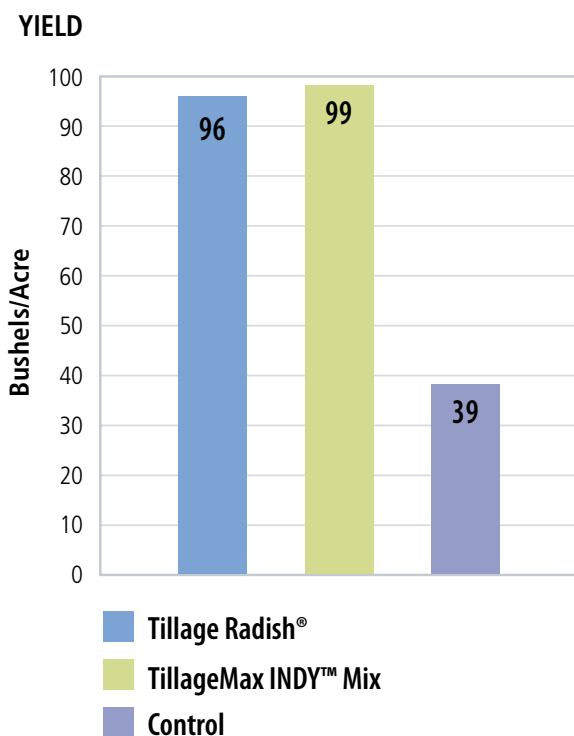
Attempt to determine the latest practical planting date for Tillage Radish® (TR) to have a positive effect on yield for corn planting following Tillage Radish® grown as a cover crop.

Tillage Radish® Planted	Corn Yield b/a	Difference b/a
Control (no TR)	136.75	—
September 20, 2010	149.21	+ 12.46
October 9, 2010	145.11	+ 8.36

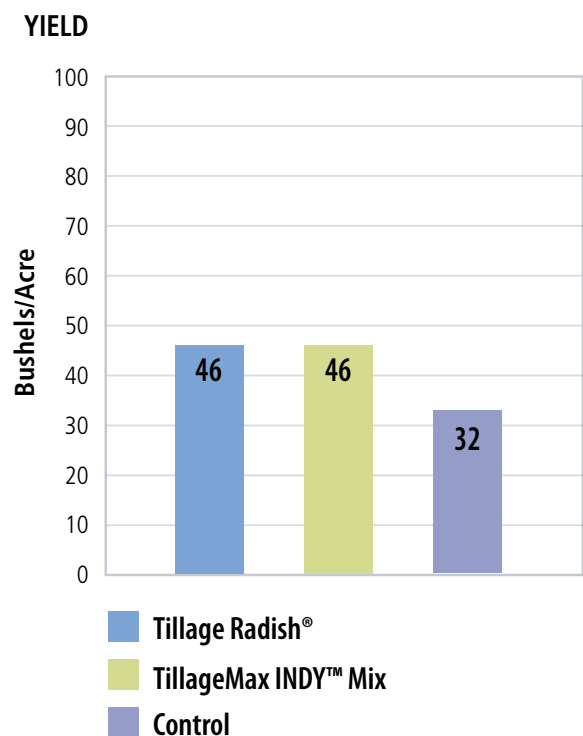
2012 Evaluation for Cover Crops
in a Dry Year (Illinois)

All plots received normal fertility

Field Corn



Soybeans



2012 Cover Crop Research

2012 Soybean Yield Research (Dry Year - Illinois)

Bare Field	23.5 bu/ac
TillageMax BRISTOL™ Mix	42.7 bu/ac
Tillage RootMax™ Deep Root Annual Ryegrass™	42.9 bu/ac
TillageMax INDY™ Mix	54.3 bu/ac

2012 Corn Yield Research (Extreme Dry Year - Illinois)

Treatment yield bu/acre

Bare Corn Stalks	43.4 bu/ac
Tillage RootMax™ Deep Root Annual Ryegrass™	95.8 bu/ac

2012 Corn Yield Research (Extreme Dry Year - Illinois)

Tillage RootMax™ / Crimson Clover Deep Root Annual Ryegrass™ Late killed - poor management in dry spring	25.6 bu/ac
TillageMax INDY™ Mix	139.0 bu/ac
Tillage RootMax™ / Tillage Radish® / Hairy Vetch Deep Root Annual Ryegrass™	147.1 bu/ac
Tillage RootMax™ / Tillage Radish® / Hairy Vetch Deep Root Annual Ryegrass™ Early killed - planted on 30" radish row	180.4 bu/ac
	Lsd .05 12



Farmers say, “It pays to use Tillage Radish®”

“Tillage Radish® is a bio sub-soiler. They are a good reason to park the steel!” — **Mike Phillips, Virginia**

“The ground where I’d planted Tillage Radish® in the fall was the mellowest I had this spring. I am tickled-to-death with them.” — **Brian Melvin, Delaware**

“Real good stand last fall; this spring the field worked up just like it had been gone over with a rototiller. We disced twice and planted corn. The field looks lovely, even and green.” — **Mike Steevers, Gadshill, ON**

“So much better than Oilseed Radish!”
— **Rod Secord, Secord Farms, Thamesville, ON**

“Last fall I used 2 pounds of Tillage Radish® when I planted the wheat. In the States, they are claiming a yield increase.”
— **Dave Van Raay, Charing Cross, ON**

“Tillage Radish® worked really well and I want more seed for this year.” — **Dan Jantzi, Baden, ON**

“We absolutely loved what Tillage Radish® did to our mostly clay soils. We won’t need to subsoil as much anymore – the radishes really do the trick! Our best looking corn is where Tillage Radish® was planted.”
— **Lyle Tabb, West Virginia**

“Tillage Radish® was everything I expected. You can literally see a difference in the soil... Unbelievable!”
— **Gary Sweet, Ohio**

“It looks like it did the job!”
— **Gardiner Farm Inc., Kirkton, ON**

“In one pass, with Tillage Radish® at a reasonable cost, I got aeration, compaction reduction, erosion control, carbon addition, organic matter and a bio-stimulant. Corn on the field this year looks excellent.”

— **Dan Breen, Putnam, ON**

“We have been using Tillage Radish® as a cover crop for the past 4 years. The radish has done its bio-drilling, and seems to leave a “film” over the top of the ground that inhibits the spring weed flush. The field looks as if you have run an AerWay over the ground from the decaying radish holes. We feel the radish does help to reduce the compaction because of the aggressive root growth. We have seen roots in excess of 3 feet on our farms. We plan to plant over 500 acres of Tillage Radish® this year.”

— **Furmano Foods, Pennsylvania**

“It’s a keeper! We noticed right to the row the difference in how mellow the soil was where the plot of Tillage Radish® was planted.” — **Eugene Lapp, Pennsylvania**

“We didn’t have to strip-till where Tillage Radish® was planted. They really softened up our clay soil! Also, our pre-side-dress nitrate testing indicated we didn’t need as much nitrogen where Tillage Radish® was planted.”

— **Patterson Farms, New York**

“I’ve planted Tillage Radish® for the last four years. They are a great addition for a diversified cover crop mix.”

— **Ray Styer, North Carolina**

“There were no winter annual weeds or crusting where Tillage Radish® was planted. We direct seeded our organic beets and had a great stand. For early spring planting there’s nothing like it!” — **One Straw Farm, Maryland**



Cover Crop Solutions (CCS) Seed Planting Guide

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Cover Crops That Pay!™

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Cover Crop Solutions
800-767-9441
CoverCropSolutions.com



Scan code
for additional
planting
information

	Planting Window Weeks before Avg. First Killing Frost	Seeding Depth Inches	Drilled (7.5" rows) Seeding Rate Lbs/Acre	Comparable Seed on Drill Chart	Can use small seed box?	Broadcast Seeding Rate Lbs/Acre	Precision Planting (PP) Refer to bag label for seeds per lb.	(PP) 15" rows Lbs/Acre*
Tillage Radish®	3 to 10	.25 to 1	6	Alfalfa (reduce by 10%)	Yes	8-10	Small Sugar Beet Plate	4
Tillage RootMax™ Certified Annual Ryegrass	3 to 10	3/8 to .5	12	Tall Fescue (reduce by 20%), Crested Wheat Grass (reduce by 10%) or Annual Ryegrass	Yes	15	Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)	10 (1.5" spacing)
Phacelia	March to May, Aug. to Sept.	.5	7	Alfalfa	Yes	Not Rec.	Not Rec.	Not Rec.
CCS Fridge Triticale	4 weeks prior to first killing frost to 6 weeks after	1 to 1.5	40	Wheat	No	60	Kinze Brush Meter - 60 cell Soybean Plate (2" in-row) White - Wheat Plate	26
Nitrogen Producing Cover Crop Legumes (specific inoculant required)								
CCS Winter Pea	3 to 10	1 to 1.5	40	Soybean	No	Not Rec.	Soybean Plate	26
CCS Crimson Clover	3 to 10	.25 to .5	12	Crimson Clover	Yes	15	Not Rec.	Not Rec.
CCS Lupin Sweet Blue Lupin	3 to 10	1 to 1.5	40	Soybean	No	Not Rec.	Soybean Plate	30
CCS Hairy Vetch	2 to 10	.5 to 1.5	15	Vetch or Sorghum	No	20	Small Sugar Beet Plate	7
Tillage Sunn™	Anytime after frost free date in Spring/8 weeks prior to killing frost in Fall	.5 to 1	15	Wheat	No	Not Rec.	Small Sugar Beet Plate	9
Exclusive TillageMax Cover Crop Mixes								
TillageMax INDY™ Mix Tillage Radish® + Tillage RootMax™ + CCS Crimson Clover	3 to 10	.25 to 1	15	Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%) or Annual Ryegrass	No	17	Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)	12 (2" spacing)
TillageMax BRISTOL™ Mix Tillage Radish® + Tillage RootMax™	3 to 10	.25 to 1	12	Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%) or Annual Ryegrass	No	15	Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)	10 (1.75" spacing)
TillageMax DAYTONA™ Mix Tillage Radish® + CCS Crimson Clover	3 to 10	.25 to 1	10	Alfalfa	Yes	13	Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)	8 (1.5" spacing)
TillageMax DOVER™ Mix Tillage Radish® + CCS Oats	3 to 10	.5 to 1	25	Oats	No	30	Kinze Brush Meter with Backing Plate (60 Cell Soybean Plate)	20 (5" spacing)
TillageMax CHARLOTTE™ Mix Tillage Radish® + CCS Fridge Triticale + CCS Crimson Clover	3 to 10	1	40	Wheat	No	50	Kinze Brush Meter with Backing Plate (60 Cell Soybean Plate)	30 (5" spacing)
TillageMax TALLADEGA™ Mix Tillage Radish® + CCS Fridge Triticale	3 to 10	1	40	Wheat	No	50	Kinze Brush Meter with Backing Plate (60 Cell Soybean Plate)	30 (5" spacing)
TillageMax HOMESTEAD™ Mix Tillage Radish® + Tillage Sunn™ + CCS Pearl Millet	Anytime after frost free date in Spring/8 weeks prior to killing frost in Fall	1	15	Wheat	No	Not Rec.	Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)	12 (2" spacing)

IMPORTANT: CHARTS ARE ONLY A GUIDE. RATES ARE AFFECTED BY SEED SIZE AND QUALITY, EQUIPMENT CALIBRATION, WHEEL SLIPPAGE, SOIL FERTILITY AND RAINFALL, ETC.

Not Rec. = Not Recommended

* Use the 15" rows as a reference for alternating rows

Kinze Brush Meter- 7878 Milo Plate, D7879 Soybean Plate

Small Sugar Beet Plate- John Deere Pro or MaxEmerge Vacuum-A51712 (increase speed by 35%), Kinze Edge Vac-D17050, Kinze Brush Meter-GA5795, White-854047, Case/IH 1200 Series-236027A2 (Old Milo Drums improve population), Monosem-6020, Precision Planting (eSet Disc-720220 (run vacuum at 15")

Guidelines to Aerial Seeding

If the fields are moist, fly seeds on.

If fields are dry, push seeds in.

Seeding rate adjustments, based on drilling rate

Broadcasting - Increase seeding rate by 25%

Aerial Seeding - Increase seeding rate by 30%

Forage Seeding - Increase seeding rate by 30%

Precision Planting - Decrease rate 10% to 50%

Late Planting - Increase seeding rate 10-20%

For SEED BLENDS and MIXTURES

To calculate a setting for seed blends and mixtures, add index settings for quantity of each seed to be sown: Ex to sow 2 lbs of Tillage Radish® and 10 lbs of Tillage RootMax™ "Deep Root Annual Ryegrass" use the index setting for each seed and add them together to set shifter on the proper notch.

Smaller seeds like CCS Crimson Clover require no adjustments.

Adjust calibration based on apparent seed weight.

INCREASE index setting for seed lighter than average seed.

DECREASE index setting for seed heavier than average seed.

Approximate guide for ideal seeding depth is 6 to 8 times the thickness of the seed.

Note- Please place this Seed Planting Guide next to your seed box charts.

For more information or to find a dealer, call or visit:
800-767-9441 • CoverCropSolutions.com



509 West Penn Ave, Suite 10 • Robeson, PA 19551

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