May 3, 2016

IOWA INSTRUCTION 300-384 – STATE WATER QUALITY INITIATIVE AND COST-SHARE INSTALLED MANAGEMENT PRACTICES

IA384.0 PURPOSE

Provide quality Conservation Technical Consultation to implement state water quality initiative and cost-share practices that meet our client's objectives and State Nutrient Reduction Strategy.

IA384.1 SCOPE

This will be followed by all NRCS employees.

IA384.2 FILING INSTRUCTIONS

This Iowa Instruction will be posted on the Iowa NRCS Employee Website, which can be accessed under the Topics/People/NRCS Employees/Iowa NRCS eDirectives or at this link Iowa NRCS eDirectives website.

IA384.3 EXHIBITS

See attached.

/s/Kurt Simon
State Conservationist

Attachment

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IDALS-DSCWQ

Natural Resources Conservation Service
210 Walnut Street, Room 693
Des Moines, IA 50309-2180
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IOWA INSTRUCTION 300-384 – STATE WATER QUALITY INITIATIVE AND COST-SHARE INSTALLED MANAGEMENT PRACTICES

1. PURPOSE:

Provide quality Conservation Technical Consultation to implement state water quality initiative and state cost-share practices that meet our client's objectives and State Nutrient Reduction Strategy.

2. POLICY.

Title 440, Conservation Programs Manual (CPM), Part 525, Subpart C, Section 525.20(f), "Conservation Technical Consultation."

3. ROLES AND RESPONSIBILITIES:

Iowa NRCS has agreed to provide verification of practice implementation for water quality initiative and state cost share installed management practices for cover crops, no-till, and nitrification inhibitors. NRCS field office staff can verify cover crop and no-till practices for each producer.

This decision was made to support our conservation partner and their programs, and aide in the adoption of these management practices.

NRCS' role will be to field verify that these practices have been implemented or not. We are exercising no control over the action and therefore it is determined there will be no federal action for this type of activity.

NRCS will provide technical assistance through the following actions:

- Provide appropriate job sheets and tech notes to participants.
    - Iowa Cover Crop Job Sheet
    - Iowa Residue and Tillage Management Job Sheet
    - Iowa Agronomy Technical Note 36
    - Iowa Agronomy Technical Note 38
    - Iowa Agronomy Technical Note 39
- To verify that a cover crop has been seeded, NRCS staff will assist by completing a field visual inspection. NRCS staff may also assist in the review of seeding rates to insure they align with the most recent guidance.
- To verify residue management, no-till/strip-till, NRCS staff will visually inspect after planting.
- The verification on nitrification inhibitors will be handled by the State Conservation Assistance and NRCS will have no role.

NRCS will not provide a conservation plan, environmental evaluation, or prepare a Form NRCS CPA-52, "Environmental Evaluation Worksheet" for these three practices installed with state cost-share. NRCS will be providing Conservation Technical

Consultation only for these practices. Covered under the current policy for "*conservation technical consultation"* in 440-CPM, Part 525, Subpart C, Section 525.20(f), identified below.

F. Conservation Technical Consultation

Technical consultation is technical assistance provided to individuals, groups, and units of government that **does not lead to the development of a conservation plan**. This technical consultation assistance includes—

(i) Assistance in meetings to support locally led efforts.

(ii) Responses to requests for information or other technical products.

(iii) Resource inventories and evaluations that may lead to conservation practice recommendations**.**

(iv) Assistance provided when there is a single transaction involving a service or product.

By providing this service, it is my hope and vision that many of these farmers, after experiencing the benefits of these cost-share practices, will return for more in-depth conservation planning and program participation.

Approved By: /s/ Date: May 4, 2016

Kurt Simon
State Conservationist
Natural Resources Conservation Service
210 Walnut Street, Room 693
Des Moines, IA 50309-2180

Attachments

Exhibit A – Iowa Cover Crop Job Sheet
Exhibit B – Iowa Residue and Tillage Management Job Sheet
Exhibit C – Iowa Agronomy Technical Note 36
Exhibit D – Iowa Agronomy Technical Note 38
Exhibit E – Iowa Agronomy Technical Note 39

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TECHNICAL NOTE: IOWA AGRONOMY TECHNICAL NOTE 39
RECOMMENDED COVER CROP SEEDING METHODS AND TOOLS

Cover Crops provide numerous benefits, and these are greatest when a good stand is established with as little soil disturbance as possible. To maximize benefits and to meet the criteria of the FOTG-329- Residue and Tillage Management Standard, the seeding tool or method should have a calculated Soil Tillage Intensity Rating (STIR) rating of 15 or less according to the Revised Universal Soil Loss Equation (RUSLE2).

Cover Crop Establishment

Cover Crop success is dependent on several factors:

- Seeding date
- Weather (temperature and moisture) after seeding
- Seedbed conditions
- Fertility
- Mulch or previous crop residue amounts
- Planting depth
- Seed soil contact
- Seeding rate
- Seed quality (% germination and % purity)
- Time of freeze after seeding
- Insects and diseases

Seeding Depth Guidance

Groups	Optimum	Maximum
Brassicas, Clovers, Small Seeded Legumes, Small Seeded Grasses	1/4″	3/4″
Vetches, Sorghums	1/2″	1″
Cereal Grains	3/4″	1 1/2″
Beans, Peas	1 1/2″	2″

Cover crop mix with excellent establishment.

The following are recommended seeding methods and tools which optimize establishment factors. Each has been evaluated for their relative establishment effectiveness for: depth control, seed to soil contact, timeliness and weather conditions.

No-Till Drilling: Use a no-till drill that is designed to handle heavy crop residues and the type of seed being planted (especially important for small seeded species). Set properly, the no-till drill will provide good seed-to-soil contact and a planting depth preferred for the desired species to be planted. This should provide for faster and more consistent emergence and is recommended for seeding species during the final days of the approved seeding period. Depth control for most drills is not as precise as a planter, so it is important to set it for the optimum depth, and check often to assure placement doesn't exceed the maximum depth for selected species. Drilling in soils that are too wet can also cause improper seed placement and be antagonistic to the desired soil health benefits. Seed at the full base rate of 100%. (See Table 1)

Narrow Row Planting: Many split-row or narrow row planters (15" row width or less) can be equipped with seed plates, such as those used for sugar beets or sorghum, which work well for many cover crop species. Additional adaptation and/or calibration may be necessary due to variation of seed size among cover crop species and varieties. This method should provide the fastest and most consistent emergence and is recommended for seeding species during the final days of the approved seeding period. To improve crop diversity at least two species of cover crops could be planted either in alternating rows or combined together. This method should not be used if weed control is the primary purpose. Seed at the full base rate of 100%. (See Table 1)

Narrow row or split-row planter

Two species of cover crops growing in alternating 15" rows.

Harrow Seeding: Rotary harrows, coulter harrow type vertical tillage tools or similar tools can be used to aid in fluffing or cutting residue to allow improved seed to soil contact over broadcasting alone but may lack the depth control of planters and drills. Air delivery seeders can be mounted to these tools to deliver the seed to the soil as the residue is lifted or cut. The implement will be set to run no deeper than 1" and not be designed to invert the soil or to bury the crop residue. Coulters will be set to run straight and not be cupped or concave. Tools with multiple operation gangs should only utilize the coulters with the rear harrow gangs raised or detached. This prevents excessive soil disturbance and moisture and carbon loss that will reduce the desired benefits of the cover crop. This will be a fast, single pass operation, that can seed many acres in a short period of time. Adjust seed up to 110% of base rate. (See Table 1)

Rotary Harrow Seeding - mounted air delivery seeder in light crop residue

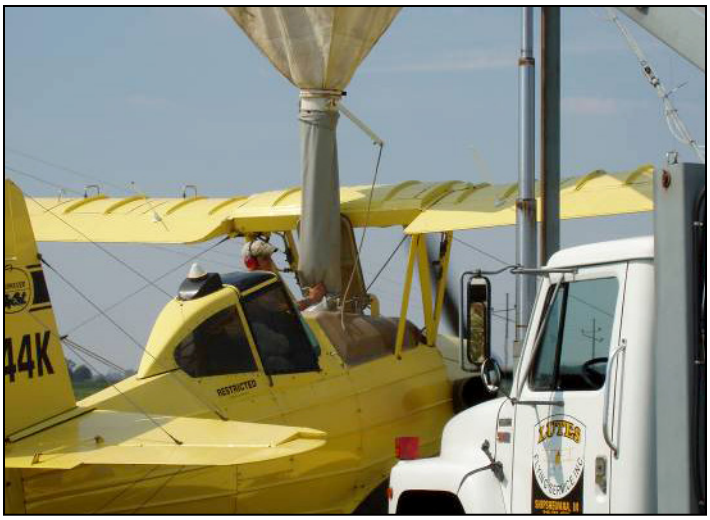
Rotary Harrow Seeding - seed delivery ports

Coulter Harrow (vertical tillage tool) Seeding - air delivery seeder on a coulter harrow in heavy crop residue

Broadcast Seeding: Seed may be inexpensively broadcast into light residue crops without a seedbed preparation if completed in a uniform manner. Expect only fair seed-to-soil contact with no planting depth. This method relies on rain, freeze/thaw cycles, or snow to incorporate the seed. Heavier seeds such as cereal grains are more adapted to this method when seeding into freshly harvested crop residues. Seeding rates should be adjusted up to 120% of base rate. (See Table 1) Pre-mixing the seed with 200 lbs. per acre of pelletized lime or blended with the fertilizer intended for the subsequent crop is acceptable if using an airflow applicator. Seed blended with fertilizer should be immediately spread to prevent damage to the seed. Wind speed should be 15 m.p.h. or less when broadcasting light seed, such as annual ryegrass.

Airflow Applicator

Aerial Inter-Crop Seeding: Broadcast via a plane, helicopter or high-clearance spreader into existing vegetation or standing crops. This method relies on rain, freeze/thaw cycles, or snow to incorporate the seed. Timing in the fall should be just prior to leaf drop or early crop maturity stage for most cover crops. This method may provide more timely seeding for species that require an earlier establishment. Some shade tolerant species may be adapted to earlier seeding. Earlier seeding is desirable when the cover crop is to be used for fall forage. An attempt should be made to seed just ahead of predicted rain. Seeding rates should be adjusted up to 120% of base rate. (See Table 1) Only seed mixes of species with similar density should be considered. Aerial applicators should be knowledgeable of the spreading width and the weight of the planned species. Wind speed should be 15 m.p.h. or less when broadcasting. It does not include a seedbed preparation. In dry years, this method may provide poor or inconsistent emergence compared to planting or drilling.



Aerial Inter-Crop Seeding

Aerial Inter-Crop Seeding - established in standing soybeans

High-Clearance Sprayer, converted to air seed cover crops
(photo courtesy of Mike Shuter)

Other approved Innovations: Air delivery seeders can be mounted to combine heads to deliver the seed to the soil as the residue is being cut or shredded. As the residues exit the back of the combine they are spread as mulch over the seed to allow improved seed to soil contact and emergence rates over broadcasting alone. Mixes with smaller seed size may be preferable to reduce seed hopper filling frequency. Seed at 110% of base rate. (See Table 1) Additional seeding innovations are likely and should be evaluated on a case by case basis.

Air seeder mounted to corn head *(photo by Ray McCormick)*

Table 1

Late Summer and Fall Cover Crop Seeding Rates

Species Common Name	Winter Hardy?	Drilled Base Rate (lbs/acre of PLS)	Broadcast with Incorporation Base Rate = 1.1 x base rate (lbs/acre of PLS)	Broadcast on Surface Base Rate = 1.2 x base rate (lbs/acre)
Rye, Winter Cereal	Yes - all cultivars	55	61	66
Triticale, Winter	Yes - most cultivars	55	61	66
Wheat, Winter	Yes - many cultivars	55	61	66
Barley, Winter	No	60	66	72
Oats	No	60	66	72
Ryegrass, Annual	No/Sometimes	12	13	14
Mustard, Oriental	No	3	3	4
Radish, Oilseed	No	5	6	6
Rapeseed	No	3	3	4
Turnip, Forage type	No	3	3	4
Vetch, Hairy	Usually/Slow Growth	12	13	14

PLS (Pure Live Seed) - Expression of seeding rate in pounds per acre
PLS = (% germination + dormant seed x % purity) ÷ 100

Late Summer and Fall Cover Crop Recommended Planting Dates

Zone (See Map[2])	Drilled or Incorporated Planting Date[1] for Winter Hardy Cover Crops	Drilled or Incorporated Planting Date[1] for Cool Season Non-Winter Hardy Cover Crops
Zone 1	October 21	September 9
Zone 2	October 28	September 16
Zone 3	November 5	September 23

[1]When surface broadcasting, plant 7 days earlier than the recommended date to compensate for slower establishment and variable rainfall. Surface broadcasting becomes less effective because of reduced tillering or branching later in planting windows, especially after non-winter hardy planting dates.

[2]See "NRCS Technical Note 38: Cover Crop Management" for Zone map.

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TECHNICAL NOTE

IOWA AGRONOMY TECHNICAL NOTE 38: COVER CROP MANAGEMENT

COVER CROP BENEFITS

Erosion Control: Cover crops reduce soil erosion in several ways. They protect the soil surface from raindrop impact, increase water infiltration, trap and secure crop residues, improve soil aggregate stability and provide a network of roots which protect soil from flowing water.

Nitrate Loss Reduction: Nitrate losses from Iowa cropland can find its way to surface waters through surface runoff and tile. Studies show that as much as 80% of these losses can occur during the winter fallow period and into the spring. Many cover crops are good scavengers of nitrogen and will take up excess nitrogen and store it in plant tissues through the winter and early spring. Studies at the USDA-ARS National Laboratory for Agriculture and the Environment (NLAE) have shown that a winter cover crop of Cereal Rye can reduce the total nitrate loading in drainage systems by 55%. Some of this nitrogen will be available to the following crop and most of the rest is stored in the soil organic matter.

Phosphorus Loss Reduction: Phosphorus loss from Iowa fields occurs in both soluble and particulate (i.e. attached to soil particles or organic manure or crop residues) forms. Cover crops reduce runoff of soluble phosphorus through increased infiltration and plant uptake. Particulate phosphorus loss is reduced by trapping organic residues and reducing soil erosion.

Atmospheric Nitrogen Fixation into the Soil: Legume cover crops can fix nitrogen, and if they grow enough they can reduce additions of nitrogen for the subsequent crop. All legumes require Rhizobium bacteria to fix nitrogen. In many cases these are Rhizobium strains specific to individual species of legumes. Assure the proper inoculant is applied to the seed just before planting. Use only fresh inoculant (check the date). See Reference: (SARE) "Managing Cover Crops Profitably, 3rd edition", page 122, *Nodulation* and Chart 3B. *planting*.

Weed Suppression: Cereal Grains, especially Cereal Rye, are very effective in providing a mulch that will create a weed barrier by blocking sunlight and producing natural chemicals which suppress weed growth.

Soil Health Improvement: Cover crops have the potential to increase soil organic matter and increase the biodiversity of organisms in the soil. This increase is greater where less tillage is used to establish the cover crop and more growth is allowed prior to spring termination. Studies show that tillage prior to seeding or as a part of seeding may cause a greater net loss of carbon than the cover crop can regain. Additionally, cover crop roots can penetrate compacted soil layers and maintain or open channels or macropores through the soil, which increases infiltration, aeration, and rooting depth. Increased biodiversity from cover crops can increase populations of beneficial organisms such as earthworms and other soil organisms such as mycorhizae which greatly improve nutrient cycling, aeration and improve soil structure. Select cover crop species to achieve one or more of the following: a species mix with different maturity dates and/or physiology, attract beneficial insects, attract pollinators, increase biological diversity to a crop rotation, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management.

Cover Crop Grazing: Research has shown that cover crop grazing can improve soil health more rapidly than cover crops alone as part of a cropping system. Livestock converts above ground biomass to urine and manure, creating a beneficial environment that increases organic matter in the soil. Grazing should be used as a tool primarily in the later part of the cover crop growth cycle to: terminate the cover crop, convert biomass into urine and manure, and potentially create more cash flow. Generally, the cover crop should be 6 inches or taller to begin grazing. Higher density strip grazing or a similar method will maximize the benefit by ensuring even distribution of animal wastes.

When a cover crop will be grazed or hayed, ensure the selected crop complies with pesticide label rotational crop restrictions and that the planned management will not compromise the selected conservation purpose(s). See Iowa State University publication Crop 3082 "Herbicide Use My Restrict Grazing Options for Cover Crops."

SITE PREPARATION & WEED CONTROL

Preceding crop residues should be spread evenly before seeding or following aerial seeding. Existing weeds should be eliminated by applying herbicide if it is determined that sufficient pressure exists to hinder the establishment and growth of the cover crop or perennial weeds are present. If spraying, work with a local consultant or Iowa State University Extension Specialist to determine the best herbicide combination and timing. Follow the manufacturer's label rates and guidelines when applying herbicides. Herbicide residue or carryover from previous crop can cause problems with cover crop establishment. A bioassey test is recommended to determine if a herbicide carry over is present.

SEEDING

Selection of Plant Materials: Use certified (Tested) seed that has been cleaned and is free from noxious weeds. Select a species that is adaptable to the desired planting date with ample time to germinate and reach an acceptable growth stage prior to a killing

freeze or adequate root growth to survive the winter. **See Table 1 "Late Summer & Fall Cover Crop Seeding Rates".** Select a species or mix which will meet the intended purpose and maximize the desired benefits. **See references.**

No-till Seeding: Ensure the drill or planter (15" rows or less) is designed to handle the crop residues and seed being planted (especially important for small seeds or mixture with varying size and/or density). Set and operate the drill/planter to provide an ideal planting depth. Seed at the full base rate of 100%. (See Table 1)

Broadcast Seeding: Seed may be broadcast using a broadcast seeder if capable of spreading seed in a uniform manner. Premixing the seed with needed fertilizer or pelletized lime and utilizing an airflow applicator can also be effective. Seed at 110% of base rate if seed is incorporated with light tillage or cultipacking. Seed at 120% of base rate if there is no incorporation. (See Table 1)

Aerial Seeding: Over seeding into the existing crop in August through September can be an effective seeding method to acquire more fall growth. Seed spread on the surface is more rain dependent, generally requires a higher seeding rate, and takes longer to establish. Seeding cover crops just ahead of soybean leaf drop will aid in mulching the seed and conserving moisture. Results are dependent on adequate rainfall. Seed at 120% of base rate. (See Table 1)

Lime and Fertilizer: Fertilizer is not recommended (this includes nitrogen) for the establishment of the

cover crop, but may be used to increase biomass production on poor or damaged sites or for grazing. The cover crop may be used to sequester or trap nutrients from manure or fertilizer applied for the subsequent crop. Lime application in conjunction with a cover crop is advantageous to improve soil quality benefits where pH is less than 6.4. Apply all soil amendments prior to seedbed preparation where possible, or before planting if a no-till drill is used.

TERMINATION

For most cropping systems, it is not desirable to allow the cover crop to produce seed. Harvest for grain is not a purpose of this practice standard. Termination for winter hardy species should be done as late as possible to maximize the intended benefits. If moisture is not a concern, cover crops should be left to achieve a minimum of 8 inches in the spring to ensure adequate growth and maximum benefits.

Ensure cover crops are managed and compatible with Risk Management Agency (RMA) crop insurance and/or USDA program criteria. (See "NRCS Cover Crop Termination Guidelines" - September 2014.)

Use of Herbicides: If the cover crop is to be terminated with herbicides, assure that timing and selection of herbicides achieve a complete kill. Translocated herbicides will normally perform better under conditions that are ideal for active growth. A minimum daytime temperature above 55° and night time temperature above 45° is needed for good translocation. During cool weather periods, application should be made during the warming time of day (i.e. 9:00am-3:00pm). Avoid tank mixing herbicides that are antagonistic to translocation. Consider the following crop when selecting the herbicide for termination. Follow all federal, state, and local guidelines as well as the manufacturer's label rates and guidelines when applying herbicides. For additional information on herbicide controls, contact a local consultant or ISU Extension Specialist. Always apply herbicides according to labeled directions. See references.

Mechanical: Most cereal grains are easily terminated by mowing, crimping, haying, tillage, or heavy grazing once the cover crop has reached a reproductive growth stage.

Note: Haying a cover crop removes some of the nutrients.

Frost: Non-winter hardy species of cover crops are primarily terminated by cold winter temperatures. However, some species may have hard seed that will germinate in the spring prior to the planting of the primary cash crop, or growing plants may over-winter in mild winters, especially if there is snow cover.

OPERATION & MAINTENANCE

The cover crop should be integrated as a part of a conservation cropping system with practices such as: Continuous No-till/Strip-till, Mulch-Till, Nutrient Management, Pest Management and Waste Utilization.

REFERENCES

Midwest Cover Crop Council - Cover Crop Decision Tool - Cover Crop Selector for Iowa Counties www.mccc.msu.udu/SelectorTool/2011CCSelectorTool.pdf

Sustainable Agriculture Research and Education (SARE) "Managing Cover Crops Profitably" explores how and why cover crops work and provides all the information needed to build cover crops into any farming operation. www.sare.org/publications/.

Table 1

Late Summer and Fall Cover Crop Seeding Rates

Species Common Name	Winter Hardy?	Drilled Base Rate[1] (lbs/acre of PLS[6])	Broadcast with Incorporation Base Rate = 1.1 x base rate (lbs/acre of PLS[6])	Broadcast on Surface Base Rate[2] = 1.2 x base rate (lbs/acre of PLS[6])
Rye, Winter Cereal	Yes - all cultivars	55	61	66
Triticale, Winter	Yes - most cultivars	55	61	66
Wheat, Winter	Yes - many cultivars	55	61	66
Barley, Winter[3]	No	60	66	72
Oats	No	60	66	72
Ryegrass, Annual[4]	No/Sometimes	12	13	14
Mustard, Oriental	No	3	3	4
Radish, Oilseed	No	5	6	6
Rapeseed	No	3	3	4
Turnip, Forage type	No	3	3	4
Vetch, Hairy[5]	Usually/Slow Growth	12	13	14

Late Summer and Fall Cover Crop Recommended Planting Dates

Zone (See Map)	Drilled or Incorporated Planting Date[2] for Winter Hardy Cover Crops	Drilled or Incorporated Planting Date[2] for Cool Season Non-Winter Hardy Cover Crops
Zone 1	October 21	September 9
Zone 2	October 28	September 16
Zone 3	November 5	September 23

[1]Minimum rates are for optimum planting time windows and conditions. Seeding rates can be increased if conditions are less than optimum or for planting dates late in the planting windows. Also, the seeding rates for cover crops intended for grazing should be increased 1.5 to 2.0 times the base rate.

[2]If surface broadcasting is used, planting will occur 7-10 days earlier than recommended planting date to compensate for slower establishment and variable rainfall. Surface broadcasting becomes less effective because of reduced tillering or branching later in planting windows, especially after non-winter hardy planting dates.

[3]Winter barley is rarely winter hardy in Iowa.

[4]Some cultivars of annual ryegrass are winter hardy in Iowa.

[5]Hairy Vetch is somewhat winter hardy if enough fall growth occurs, but it grows slowly in both fall and spring. It benefits from an earlier fall planting. Soil incorporation is preferable.

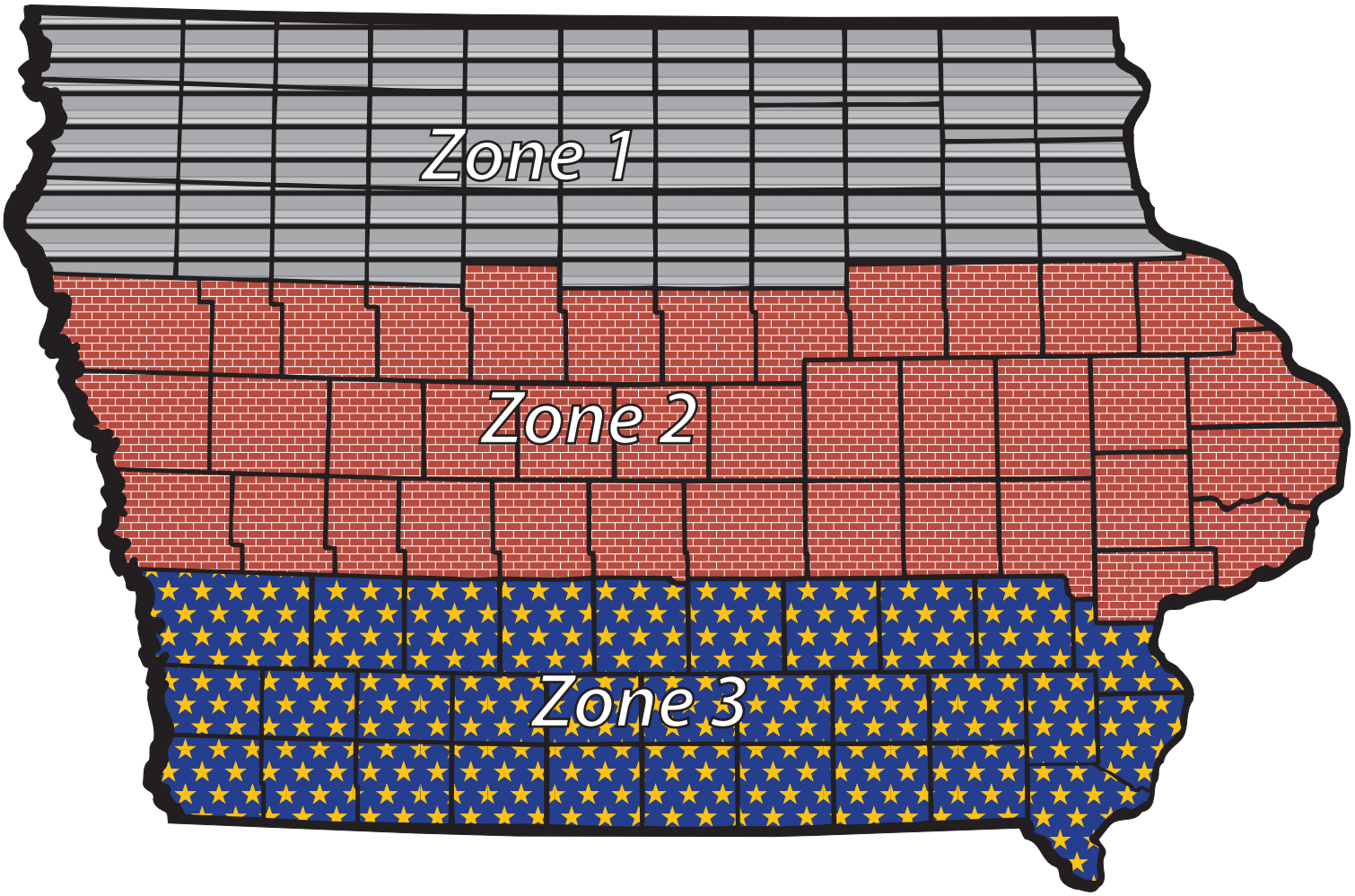
[6]PLS (Pure Live Seed) - Expression of seeding rate in pounds per acre. PLS = (% germination + dormant seed x % purity) ÷ 100

This is not an all-inclusive list of species. See Midwest Cover Crop Council-Cover Crop Decision Tool – Cover Crop Selector for Iowa Counties.

It is recommended that you plant diverse cover crop mixes. The rates listed are for pure stand seedings. When developing a cover crop mix, take the percent desired by the pure stand rate to determine seeding rate by species.

(Example: 60% cereal rye + 40% radish would have a seeding rate of .6 X 55 = 33 lbs. cereal rye and .4 X 5 = 2 lbs. radish)

Iowa Cover Crop Planting Zones



Zone 1 - Oct. 14 for winter hardy cover crops; Sept. 2 for cool season non-winter hardy cover crops

Zone 2 - Oct. 21 for winter hardy cover crops; Sept. 9 for cool season non-winter hardy cover crops

Zone 3 - Oct. 30 for winter hardy cover crops; Sept. 16 for cool season non-winter hardy cover crops

Examples of Diverse Cover Crop Mixes

See Midwest Cover Crop Council-Cover Crop Decision Tool – Cover Crop Selector for Iowa Counties for an all-inclusive species list.

Resource Concern	Species Mix	% of Pure Stand Rate	lbs./ac. of PLS[3]
SUMMER COVER (Seed by Aug. 1)			
Compaction Mix	Oilseed Radish[1]	20	1
	Turnips[1]	20	1
	Rape	30	1
	Oats	30	18
Nitrogen Fixing Mix 1	Alfalfa	30	5
	Red Clover	30	3
	Oats	40	24
Nitrogen Fixing Mix 2	Oats	50	30
	Hairy Vetch	50	6
Grazing/Compaction Mix (2x base rate for grazing)	Oats	40	48
	Mustard	20	1
	Turnip[1]	20	1
	Forage Radish[1]	20	2
FALL/WINTER COVER (Seed by zone - see map)[2]			
Soil Building/N Scavenge Mix	Cereal Grain (Cereal Rye, Winter Wheat, Winter Triticale)	85	47
	Oilseed Radish	15	1
Erosion Control Mix & Nitrogen Fixing	Cereal Grain (Cereal Rye, Winter Wheat, Winter Triticale)	60	33
	Hairy Vetch	40	5
Erosion Control	Annual Ryegrass	60	7
	Rape	20	.6
	Mustard,Oriental	20	.6
Grazing/Compaction Mix (2x base rate for grazing)	Cereal Grain (Cereal Rye, Winter Wheat, Winter Triticale)	50	55
	Oilseed Radish	25	2.75
	Turnip	25	1.5

[1]Brassicas will bolt when seeded in the spring, and will produce seed.

[2]If a non-winter hardy species is used in the mix, seed the mix by the earlier seeding date.

[3]PLS (Pure Live Seed) - Expression of seeding rate in pounds per acre. PLS = (% germination + dormant seed x % purity) ÷ 100

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TECHNICAL NOTE
IOWA AGRONOMY TECHNICAL NOTE 36: INTERSEEDING OF COVER CROPS

ESTABLISHMENT BY AERIAL BROADCAST

A big advantage of aerial seeding of cover crops is that more acres can be seeded in less time than with ground equipment. Aerial application also allows seeding to be done when it is physically impossible to use ground equipment, such as when crops are present, or the soil is too wet for regular equipment.

Seeding, germination, and growth of cover crops can begin even before the existing crop has been harvested. This is especially important in areas where there is a very small window of opportunity between crop harvest and the end of the growing season, and for winter killed broadleaf species to get enough growth. Waiting to seed a cover crop until after crop harvest may result in poor stand establishment due to cold temperatures or moisture stress.

Aerial seeding is always more risky than drilling or incorporation of the seeds, so it's important to have the right soil surface and weather conditions at seeding time.

SOIL SURFACE CONDITIONS

The surface soil must be moist and friable to enable the seed to settle into the surface and make good contact with the soil. A surface that is loose and rough, with cracks or ample residue cover, works best. With a loose and rough surface the chances of a seed making soil contact and landing in areas with soil moisture is enhanced. Residue cover conserves the surface moisture for seed germination. A flat, hard, dry soil surface is not conducive to aerial seeding success.

SOIL MOISTURE

Aerial seeding has much higher success in areas with good soil moisture and frequent precipitation in late summer or early fall. Broadcasting seed requires enough moisture in the top ½ - 1 inch of soil to ensure adequate moisture for the seed to germinate and establish. This moisture needs to be present at the time of seeding, or should be expected to occur within 10 days of seeding. If moisture is not present and germination is delayed, there is an increased chance of seed mortality from desiccation, insect damage, or animal predation. Seeding on hard, dry soil reduces the chances for germination and uniform establishment of the cover crop.

Cover crops show up in the fall prior to soybean harvest.

Harvesting soybeans shows previously seeded cereal rye cover crop.

SEED SELECTION

Most species of cover crops will produce adequate stands for winter and early spring soil protection when broadcast on the soil surface, provided that the proper weather and soil surface conditions are present. Cereal grains (e.g. wheat, rye, oats, barley, triticale) may be easily established by aerial seeding if moisture and soil conditions are suitable.

It's important to understand the characteristics of different types of plants when choosing a cover crop. Large-seeded legumes, like cowpea and vetch, establish better with good seed-to- soil contact obtained by drilling or incorporation following broadcast. When these seeds germinate, their young roots don't have the ability to penetrate the soil surface as well as other species. Legumes, like most dicots, germinate and establish better when they are in direct contact with the soil. Grasses are more adapted to germinate on the soil surface. Their young roots are smaller than those of legumes, so they can penetrate the surface crust easier. Grass roots multiply quickly once they enter the soil, creating a root mass that can absorb the water and nutrients the young plant needs.

Below are some general groupings of cover crop species, grouped by their suitability for aerial broadcast seeding. Small grains, grasses, and brassicas establish well by aerial seeding. Large seed legumes do poorly when broadcast, see group 5 below. Small-seeded legumes are intermediate, and can establish when aerially seeded under good weather and soil conditions. Another reason adequate moisture and soil contact is important for legumes is the seed inoculant. Lack of soil contact and soil moisture will reduce the effectiveness of the soil inoculant.

A very general grouping of seed selections for aerial seeding of cover crops. Local conditions and species adaptation must be applied.

Group 1 - Small grains (cereal rye, wheat, barley, oats, triticale) Seed sources are plentiful and relatively inexpensive. Seeds germinate readily on the soil surface when soil moisture is present.

A multi-species cover crop mix helps control soil erosion and supplies livestock supplemental feed.

Group 2 – Ryegrass (annual, perennial) benefits by having rain shortly after broadcasting. Aerial seeding of ryegrass requires an additional 2 pounds of seed per acre over drilling or incorporating.

Group 3a – Small-seeded brassicas (mustards, rape, canola, turnips, radishes) must be established early, about 4 weeks before the average date of a 28° F freeze. Soil temperatures need to be greater than 45° F. Small seed size allows for good soil contact.

Group 3b – Sorghum-sudan and millet require warm, moist soil conditions with soil temperature > 65° F.

Group 4 – Small-seeded legumes (clovers, medics, trefoils, alfalfa) will succeed best if drilled ¼ to ½ inch deep into the seedbed. They establish in late winter/ early spring as "frost seeding" when the soil surface is moist and conditions allow freezing and thawing to provide good seed-to-soil contact. Best success with sweet and red clovers.

Group 5 – Large-seeded legumes (beans, hairy vetch, peas, lupine, cowpeas) and buckwheat will succeed best if drilled or incorporated. **Large seeds are not recommended for aerial seeding.**

BRASSICAS FOR COVER CROPS

The mustard family of crops (brassicas such as canola, turnips, rape, mustards and radishes) are recommended as a cover crop for a number of reasons. Brassicas can suppress soil-borne diseases, nematodes, and some weeds. Brassicas have been shown to suppress diseases such as verticillium and root rots. They also increase infiltration, carbon content and percolation rates of the soil surface. They can supplement grazing for livestock in late fall and early winter.

Be aware that mustards are sensitive to broadleaf herbicide carryover, particularly 2, 4-D. Some canola varieties are glyphosate-tolerant, while other non-resistant varieties of brassicas are very sensitive to the herbicide. The small size of seed, spherical shape, and ability to germinate under cool temperatures makes the brassicas well-adapted for aerial seeding. The small seed size means there is a large number of seeds sown per acre, and the seeds roll upon impact with ground. This increases the chance they will end up in a crack or crevice where the conditions for germination and seedling growth are better.

A western Iowa organic farmer uses tillage radishes in a multi-species cover crop mix to help break soil compaction.

SEEDING RATES

Seeding rates for aerial-seeded cover crops need to be increased above rates recommended for drilled or incorporated seeding. (See Table 1) Higher seed rates are required due to a greater risk for insect damage, or rodents and birds eating seeds on the soil surface. Bird and rodent predation is particularly bad around the edge of the field, where these pests can move in from field borders or neighboring non-cropland. Increasing the seeding rate around field edges and along headlands helps offset some of the expected damages. This increases seed cost, but that may be offset by the fact that more acres can be seeded in less time, and planted when growing conditions are more favorable.

Airplanes can seed large areas with seed quickly.

TIMING OF AERIAL SEEDING

As a general rule, aerial-seeded cover crops should be sown at least 7-10 days earlier than drilled cover crops, because they are somewhat slower to establish a stand. Seeding into standing soybeans should be done before the soybeans have dropped more than 10% of their leaves. The leaf fall that will occur after seeding will act as mulch and provide good soil protection and moisture conservation. Aerial seeding into standing corn should be delayed until the kernel milk line is at least 50% formed. For silage corn, conduct aerial seeding several weeks before cutting silage, when the corn is in early dent stage. Consider current weather and air temperature before sowing into other standing crops.

Table 1

Late Summer and Fall Cover Crop Seeding Rates

Species Common Name	Winter Hardy?	Broadcast on Surface Minimum Rate = 1.2 x base rate (lbs/acre)
Rye, Winter Cereal	Yes - all cultivars	66
Triticale, Winter	Yes - most cultivars	66
Wheat, Winter	Yes - many cultivars	66
Barley, Winter[2]	No	72
Oats	No	72
Ryegrass, Annual[3]	No/Sometimes	14
Mustard, Oriental	No	4
Radish, Oilseed	No	6
Rapeseed	No	4
Turnip, Forage type	No	4
Vetch, Hairy[4]	Usually/Slow Growth	14

Late Summer and Fall Cover Crop Recommended Planting Dates

Zone (See Map[5])	Date[1] for Winter Hardy Cover Crops	Date[1] for Cool Season Non-Winter Hardy Cover Crops
Zone 1	October 14	September 2
Zone 2	October 21	September 9
Zone 3	October 30	September 16

[1]When surface broadcasting, plant early to compensate for slower establishment and variable rainfall. Surface broadcasting becomes less effective because of reduced tillering or branching later in planting windows, especially after non-winter hardy planting dates.

[2]Winter barley is rarely winter hardy in Iowa.

[3]Some cultivars of annual ryegrass are winter hardy in Iowa.

[4]Hairy Vetch is somewhat winter hardy if enough fall growth occurs, but it grows slowly in both fall and spring. It benefits from an earlier fall planting. Soil incorporation is preferable.

[5]See "NRCS Technical Note 38: Cover Crop Management" for Zone map.

Broadleaf species should be seeded in a mix with grass. Cover crop mixes with broadleaf species should not be comprised of more than 50% broadleaf species.

This is not an all-inclusive list of species. See Midwest Cover Crop Council-Cover Crop Decision Tool – Cover Crop Selector for Iowa Counties.

It is recommended that you plant diverse cover crop mixes. The rates listed are for pure stand seedings. When developing a cover crop mix, take the percent desired by the pure stand rate to determine seeding rate by species.

(Example: 60% cereal rye + 40% radish would have a seeding rate of .6 X 66 = 39.6 lbs. cereal rye and .4 X 6 = 2.4 lbs. radish)

AERIAL SEEDING EQUIPMENT

Fixed-wing vs. rotary-wing aircrafts for seeding cover crops – which is best? Both types of aircrafts are capable of quickly spreading seed above the crop canopy. Anecdotal evidence gives a slight advantage in cover crop establishment to helicopters, because the air turbulence from the blades shakes the crop canopy, preventing the seed from being caught on the leaves, and the downward pressure forces the seed onto the ground. Fixed-wing aircrafts can carry heavier loads of seed and fly faster across the field. Helicopters are more maneuverable, and can do a better job on irregularly-shaped fields and along end rows and headlands. Optimum seed drop is from a height of 50 to 60 feet above the canopy.

An airplane drops cover crop seed on a corn field.

A third method of above-canopy seeding is a high clearance vehicle, such as a high–clearance sprayer. These vehicles are slower than aerial seeding and will cause some crop damage when turning at the end of a field. Some may not have enough clearance for tall crops like corn, and their use is limited by wet soil conditions. The advantages are: many farms now own or can rent this equipment; consistently get more even seed coverage; it is available during the best time for seeding cover crops; the farmer can operate the equipment himself; and it is may be less expensive than custom aerial seeding. The main criteria for choosing between types of equipment will probably be cost of rental and availability of the equipment. However, delaying seeding to get the cheapest seeding method may mean poor establishment due to moisture conditions or shortened growing season. Timing of seeding is a crucial aspect of cover crop success.

A high-clearance sprayer is used by a northeast Iowa farmer to apply cover crop seed between corn rows.

Further Reading

Clarke, A. (ed.). 2007. Managing Cover Crops Profitably. Sustainable Agriculture Network handbook series; bk. 9.

Magdoff, F., and H. van Es. 2000. Building Soils for Better Crops (2nd ed.):. Chap. 10: Cover Crops. Sustainable Agriculture Network handbook series: bk. 4.

Singer, J., T. Kaspar, and P. Pedersen. 2005. Small Grain Cover Crops for Corn and Soybeans. Extension Publication PM-1999. Iowa State University.

Taylor, E., K. Renner, and C. Sprague. 2008. Integrated Weed Management: Fine Tuning the System. Chap. 2: Cover Crop Systems. Extension bulletin E-3065. East Lansing, Mich.: Michigan State University.

USDA

United States Department of Agriculture

Residue and Tillage Management

Iowa Job Sheet

No-till/Strip-till (329) and Reduced-till (345)

Natural Resources Conservation Service (NRCS)
Des Moines, Iowa

Iowa Conservation Practice 329/345
July 2014

Definition

Residue management is managing the amount, orientation and distribution of crop and other plant residue on the soil surface throughout the year. It includes all soil disturbing activities like tillage, nutrient applications and harvesting of residue.

Purpose

Residue and Tillage Management should be used on all cropland fields especially where excess wind, sheet and rill erosion are a problem. Residue and tillage management is most effective when used with other conservation practices like grassed waterways, contouring, field borders, etc.

Residue management systems can be designed to accomplish multiple purposes including:

- Reduced water and wind erosion.
- Maintain or increase soil organic matter.
- Increase moisture available for plant use.
- Cost savings from reduced fuel usage.
- Reduce soil particulate emissions and CO_2 losses.
- Provide food and escape cover for wildlife.

General Specifications

There are four types of residue management systems:

Reduced-till **(Mulch-till):** Full width tillage which disturbs the entire soil surface prior to planting (spring or fall). Tillage tools such as chisels, field cultivators, vertical tillage, rotary harrows, disks, sweeps or blades are used. Weeds are controlled with herbicides and/or cultivation. The annual Soil Tillage Intensity Rating (STIR) value for all soil-disturbing activities shall be no greater than 60 for mulch-till and the residue levels are adequate to achieve the desired benefits specified in the conservation plan

(Ridge Till): Soil and residue is left undisturbed from harvest to planting except for nutrient injection. Plant in seedbed prepared on ridges with sweeps, disk openers, coulters or row cleaners. Residue is left on the surface between ridges. Ridges are rebuilt during cultivation. Control weeds with herbicide and/or cultivation. Residue levels remain adequate to achieve the desired benefit specified in the conservation plan.

No-till: Soil and residue is left undisturbed from harvest to planting except for nutrient injection. Planting, drilling or nutrient application is done in a narrow seedbed or slot created by coulters, row cleaners, or disk openers No full-width tillage operations are done. Weeds are controlled with herbicide. Row cultivation should only be used for emergency weed control. This practice is also referred to as zero-till; slot till, direct seeding or slot plant. The annual Soil Tillage Intensity Rating (STIR) value for all soil disturbing activities shall be no greater than 15 for no-till and the residue levels remain adequate to achieve the desired benefit specified in the conservation plan.

(Strip-till): Soil and residue is left undisturbed from harvest to planting except for strips up to a third of the row width. No full width tillage operations are done. These strips are cleared of residue and tilled for warming and drying purposes either before or during the planting operation. This practice is also referred to as row-till, zone-till or fall strip-till. The annual Soil Tillage Intensity Rating (STIR) value for all soil disturbing activities shall be no greater than 15 for strip-till and the residue levels are adequate to

achieve the desired benefits as specified in the conservation plan.

Operation and maintenance

This practice is considered to be applied when the residue levels and STIR levels specified in the conservation plan or practice standards are achieved. The critical time to maintain good residue cover is in the spring, until a crop canopy covers the soil. To do that, start planning at harvest.

When developing and implementing your tillage system, you may want to experiment with different tillage methods on a small acreage to work out the "bugs". Many types of tillage equipment are available. You'll need to shop around to determine which will best fit your operation. Your existing equipment may be adjusted to give the desired results.

NRCS uses tillage and planting operations along with the residue levels after the planting the current year's crop to determine if a farmer is applying his/her conservation plan, so managing residue from harvest through planting is crucial. When measuring residue, NRCS uses this method:

» Use any line that is equally divided into 100 parts. Fifth foot cable transect lines are available for this purpose. Another tool is a 50' nylon rope with 100 knots, six inches a part. A 50' tape measure using the 6" marks also works well.

» Stretch the line diagonally across the rows. Count the number of marks (tabs or knots) that have residue under them when sighting from directly above one end of the mark. It is important to use the same point on each mark for accuracy. Don't count residue smaller than 1/8" in diameter.

» Walk the entire length of the rope or wire. The total number of marks with residue under them is the percent cover for the field. If your+ rope or tape has only 50 marks, multiply by 2; for 25 marks, multiply by 5.

» Repeat the procedure at least 3 times in different areas of the field, and average the findings.

Crop residue and tillage management effects on soil erosion and organic matter can also be predicted using the Revised universal Soil Loss Equation, Version 2 (RUSLE2). The RULSE2 program will also provide the Soil Conditioning Index (SCI) and Soil Tillage Intensity Rating (STIR). The SCI is a tool that can predict the consequences of cropping systems and tillage practices on soil organic matter. Organic matter is a primary indicator of soil quality. The amount of soil disturbance that occurs also has a significant impact on soil and water quality. The STIR measures the amount of soil disturbance. The STIR value is used to determine the upper limits of the amount of soil disturbance allowed in the different tillage categories. The amount of soil disturbance that occurs also has a significant impact on soil and water quality. The STIR measures the amount of soil distur-

Use this table to estimate remaining residue after each tillage operation. Check the estimates by measuring residues.

Estimated percent residue cover after field operations

Tillage Operation	Corn	Soybeans
After harvest	*.90-.95*	*.80-.90*
Over winter decomposition	*.80-.90*	*.70-.80*
Plow	.02-.07	.00-.02
Chisel (twisted shank)	*.40-.50*	*.10-.20*
Disk (off-set, deep)	.25-.40	.10-.20
Para plow	.65-.75	.35-.45
Chisel (straight shank)	.50-.60	.30-.40
Disk (tandem, shallow)	.65-.75	.25-.35
Anhydrous applicator	.75-.85	.45-.55
Field cultivator	.80-.90	.55-.65
Plant	*.80-.90*	*.80-.90**
Till-plant	.55-.65	.55-.65*

*when these are the only operations where soil is disturbed, multiply by .75

Figuring residue at each tillage operation will allow you to see which tillage operations are burying the most residue, and will help you make residue management decisions. The first step is to estimate your residue after harvest. For example, start with 90% (.90) corn residue. If you plan to chisel with a twisted shank in the fall, then multiply .9 by .5. The residue percent remaining after using the chisel is 45%. The next step is to multiply .45 by .9 to account for over-winter decomposition; so before any spring tillage you've got 40% residue. Planting leaves between 80 and 90% of that remaining residue on the soil surface. In this example, you'll have about 32% of the ground covered by reside after planting (.4 X .8 = .32). *(The operations and steps used in this example are listed in italics in the chart to the left.)*

Here's the previous example shown as a mathematical equation:
Harvest (.90) X Tillage (.5) X Overwinter (.9) X Planting (.8) = 32% Residue Left

bance. The software and database files can be obtained at: www. ia.nrcs.usda.gov/technical/RUSLE2.html.

Energy Savings

Using one of the Residue and Tillage Management systems described in this job sheet can result in reduced energy usage and cost savings. For an estimate of the amount of fuel that can be saved using a Residue Management system, visit the online energy calculator at ecat.sc.egov.usda.gov. You can also compare energy savings using RUSLE2.

Special Considerations

- Some plant varieties produce higher residue amounts.
- Higher plant populations and narrower rows increases residue at harvest
- Slower tillage speeds and shallower tillage depths leave more residue on the soil surface.
- Adjusting equipment and adding sweeps can increase residue left on the surface.
- Evenly distribute residue so it covers more soil surface. Spreader and chopper adjustments will affect the distribution and size of the residue.
- Baling, grazing and burning will reduce crop residue cover.

Producer Name:			**Date:**
FSA Tract Number:			**Fields:**
Planned by:			
Crop	**Previous Crop**	**Tillage Method***	**Target Percent Ground Cover After Planting**

***NT**: No-Till* **ST**: *Strip-Till* **MT**: *Mulch Till* **RT**: *Ridge Till*

NRCS—Iowa
July 2014

I certify that the above listed practice(s) was completed according to the NRCS standards and specifications on the field and area identified above. I understand that this practice(s) may be checked at anytime to insure compliance with the NRCS standards and specifications.

_____ _____

Landowner/Contractor/Technical Service Provider ***Signature*** *Date*

Practice(s) **(does)** or **(does not)** meet approved plans, standards and specifications.

_____ _____

NRCS Employee/SWCD Employee/Technical Service Provider ***Signature*** *Date*

_____NRCS (original) _____Cooperator (copy) _____Contractor (copy)

On NRCS copy only, attach required field notes, sketch of practice location on farm, designs, computations, measurements, and quantities. Place this information in the field office case file.

Residue Level Examples

30% Residue

Corn

Soybeans

50% Residue

Corn

Soybeans

70% Corn Residue

USDA

United States Department of Agriculture

Cover Crops

Iowa Job Sheet

Natural Resources Conservation Service (NRCS)
Des Moines, Iowa

Iowa Conservation Practice 340
April 2016

Definition

Cover crops are planted in the late summer or fall around harvest and before spring planting of the following year's crops. Common cover crops used in Iowa include winter hardy plants like cereal rye and wheat. Other less common, but also effective cover crops include oats, spring wheat, hairy vetch, red clover, sweet clover, turnips, rapeseed, radishes, and triticale.

Purpose

Cover crops reduce soil erosion, utilize excess soil nutrients, suppress weeds, minimize soil compaction, increase soil organic matter, improve soil moisture efficiency, and improve overall soil health. Cover crops increase surface cover, anchor corn and soybean residues, increase water infiltration, and reduce compaction.

In addition to the environmental and soil health benefits, several cover crops may be used for grazing forage for livestock and wildlife.

Conditions Where Practice Applies

Cover crops may be used on all lands needing seasonal vegetative cover for natural resource protection and improvement. They are an excellent tool for helping to improve soil health.

General Specifications

Seeding: Establish cover crops according to recommended seeding rates, dates, and methods provided by NRCS. For prepared seedbeds, crops should be seeded at the proper depth for fast emergence – .25 to .5 inches deep for legumes and grasses, and .75 to 1.5 inches deep for cereal grains. *(See NRCS Agronomy Technical Note 38 for Cover Crop Management, including Seeding Rates and Dates. See NRCS Agronomy Technical Notes 36 and 39 for Cover Crop Seeding Methods.)*

If seeding the cover crop prior to harvest, broadcast the seed by a method that allows for good coverage and prevents damaging the standing crop. No seedbed preparation is necessary. Seeding into standing soybeans should be completed before the soybeans have dropped more than 10% of their leaves. The leaf fall after seeding will act as

mulch and provide soil protection and moisture conservation. Broadcast seeding into standing corn should be delayed until the kernel milk line is at least 50% formed. For silage corn, broadcast seed several weeks before cutting silage, when the corn is in early dent stage. Consider current weather and air temperature before sowing into other standing crops.

Inoculate legume seed with species-specific Rhizobia bacteria before seeding. Control pests as needed to ensure cover crop development.

Cover Crop Termination: Cover crops can be terminated by harvesting, crimpers, frost, mowing, tillage or herbicides. Make sure any herbicides are compatible with the following crop. Follow all Federal, State and local laws and regulations, as well as manufacturer's label with all hebicides. Do not burn cover crop residue.

Maintenance

Cover crops should be terminated as late as feasible to maximize plant growth and residual nutrient accumulation, while allowing sufficient time for the cover crop to decompose, release nutrients, and recharge soil moisture.

Acceptable benefits, for most purposes, are usually accomplished when the combined canopy and surface cover is at least 60 percent and the above ground dry biomass production is at least 800 lbs/acre. This should be accomplished when the cover crop is 6" tall.

Cover Crops (340)

Date:		**Farm #:**	
Prepared by:		**Tract #:**	
Owner/Client:		**Acres:**	

Definition:

Grasses, legumes or forbs planted for seasonal vegetative cover.

Application:

This practice applies to all lands requiring seasonal vegetative cover for natural resource protection or improvement.

Purpose (mark all that apply)

- ☐ Reduce erosion from wind and water
- ☐ Increase soil organic matter
- ☐ Manage excess nutrients in the soil
- ☐ Promote biological nitrogen fixation
- ☐ Increase biodiversity
- ☐ Suppress weeds and break pest cycles
- ☐ Provide supplemental forage
- ☐ Improve soil moisture use efficiency
- ☐ Minimize soil compaction

	Field	Total Acres	Residue Type	Species	Seeding Rate (lbs/ ac PLS*)	Seeding Date	Seeding Method	Termination Date or Stage	Termination Method
Planned									
Actual Implementation									
Planned									
Actual Implementation									
Planned									
Actual Implementation									

* To figure Pure Live Seed (PLS) rates, multiply the percent purity by the percent germination. Divide the seeding rate by the percent PLS to find the bulk seed needed per acre.

For example: 98% purity X 60% germination = 0.588 PLS
10 lbs/acre ÷ 0.588 PLS = 17 lbs/acre

Other
- Nutrient Rate, Timing, etc.
- Management Requirements

REQUIRED DOCUMENTATION:
- All Invoices (application & seed)
- Seed tag or other PLS documentation

Note: Producer must complete the yellow portion of this form.

If you are receiving conservation financial assistance, this form is REQUIRED. Any changes need to be discussed with NRCS prior to implementation or financial assistance may not be provided.

Producer Initials & Date	Seeding Completion Certification (sign/date)