USDA
United States Department of Agriculture
Natural Resources Conservation Service

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 "Cool Season 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 drilled/incorporated rate. (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 incorporated rate if seed is incorporated with light tillage or cultipacking. Seed at broadcast on surface 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 resulting in less consistency of establishment and application is often spotty. 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 broadcast on surface 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.edu/selector-tool

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. https://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition

Table 1

Cool Season Cover Crop Seeding Rates *(minimum rates[1])*

Species Common Name	Winter Hardy?	Drilled or Incorporated (Bulk lbs/acre[5])	Broadcast on Surface (Bulk lbs/acre[5])
Rye, Winter Cereal	Yes - all cultivars	45	45
Triticale, Winter	Yes - most cultivars	45	45
Wheat, Winter	Yes - many cultivars	45	45
Barley, Winter[2]	No	60	60
Oats	No	60	60
Ryegrass, Annual[3]	No/Sometimes	12	14
Mustard, Oriental	No	3	4
Radish, Oilseed	No	5	6
Rapeseed	No	3	4
Turnip, Forage type	No	3	4
Vetch, Hairy[4]	Usually/Slow Growth	12	14

Cool Season Cover Crop Recommended Planting Dates

Zone (See Map)	Winter Hardy Cover Crops	Non-Winter Hardy Cover Crops
Zone 1	October 21	September 9
Zone 2	October 28	September 16
Zone 3	November 5	September 23

[1]Seeding rates are for optimum planting dates and conditions. Rates can be increased if conditions warrant. When using cover crops for weed control or grazing, consider increasing the rate by 1.5 to 2.0 times the minimum rate.

[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]Bulk seed must be a minimum of 85% PLS (Pure Live Seed). For seed lots testing below the minimum the seed rate must be based on PLS and not the bulk seed rate. PLS = Purity * % total Germination (germination + hard seed) / 100. All seed must be tested by approved ICIA (Iowa Crop Improvement Association) lab.

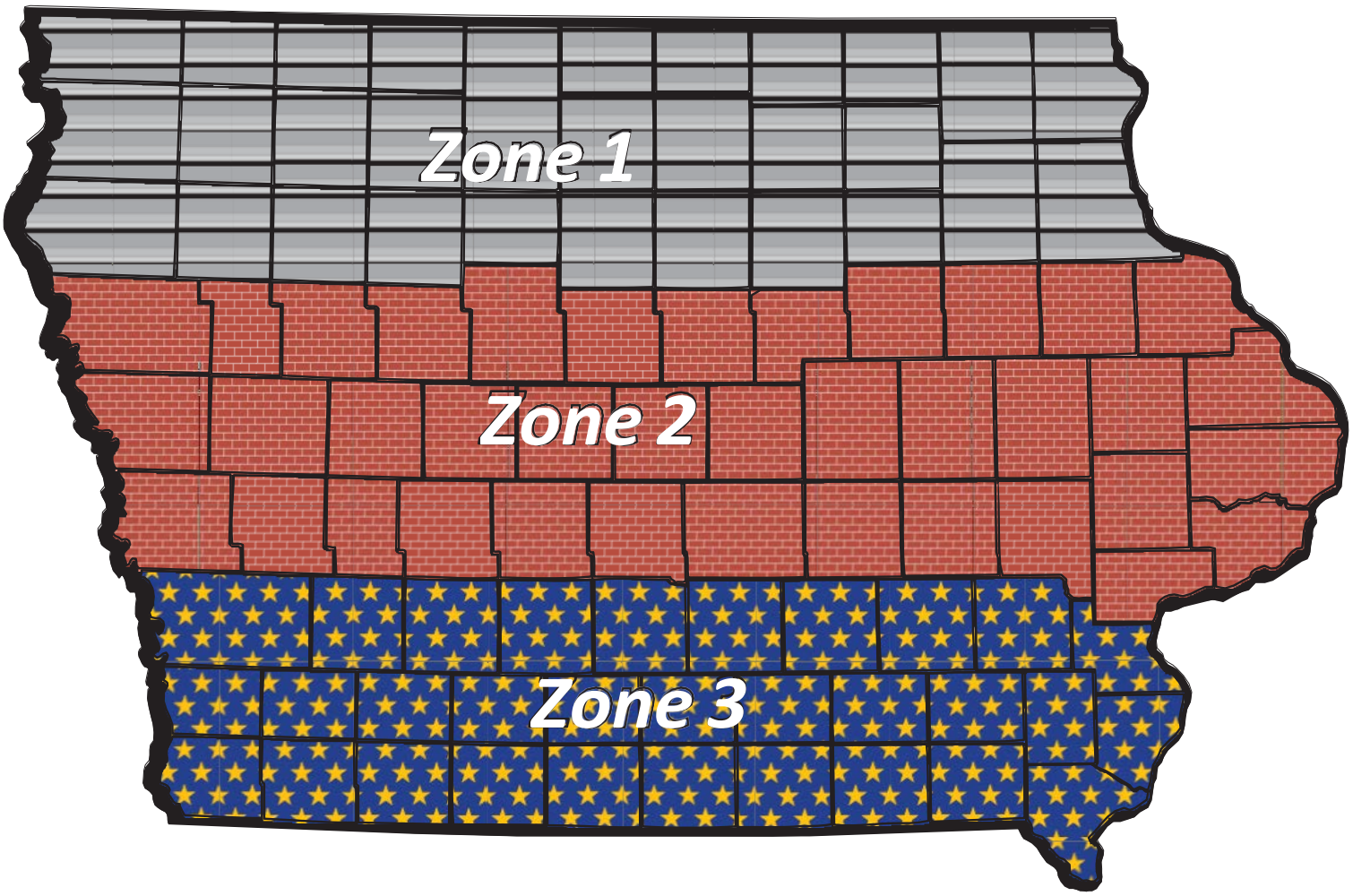
This is not an all-inclusive list of species. See Midwest Cover Crop Council-Cover Crop Decision Tool – Cover Crop Selector for Iowa Counties.

Up to 20% of the seed mix can be other species not listed in the MCCC's-Cover Crop Decision Tool if approved by the ARC (Area Resource Conservationist). The ARC will determine the lbs. of the species needed to meet the % of seed mix up to the 20% limit.

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 45 = 27 lbs. cereal rye and .4 X 5 = 2 lbs. radish)

Iowa Cover Crop Planting Zones



Zone 1 - Oct. 21 for winter hardy cover crops; Sept. 9 for non-winter hardy cover crops

Zone 2 - Oct. 28 for winter hardy cover crops; Sept. 16 for non-winter hardy cover crops

Zone 3 - Nov. 5 for winter hardy cover crops; Sept. 23 for 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