DESIGN, INSTALLATION, CHECK OUT, AND DOCUMENTATION
Cover Crop – 340

Cover Crop (340) shall be planned and installed in accordance with the NRCS standard, as detailed in Section IV – Conservation Practices subfolder of the North Dakota Field Office Technical Guide (FOTG). This document provides additional parameters, recommendations, references, and requirements for developing site-specific plans for this practice.

GENERAL DESIGN INFORMATION

Cover crops are crops which are not usually grown for harvest, but which serve multiple functions in crop rotation systems. Cover crops are typically grown to prevent soil erosion or for improvement of soil quality, however, other important roles include the enhancement of soil structure, improvement of soil fertility, enhancement or preservation of environmental quality, and in the management of weeds, insect pests, and plant pathogens.

Producers often want to achieve more than one purpose with this practice. It is important to select the best species – or species mixture - to achieve the intended purpose(s) or primary use. Generally, no single cover crop species is ideal for all purposes. Criteria for the primary purpose of the cover crop selected by the decision-maker and identified in the cover crop standard shall be met. Achieving multiple purposes usually requires some compromise in the selection of species or mixture of species to plant. It is not required – and may not be possible – to meet all of the Additional Criteria for each additional purpose designated by the decision-maker.

Table 1, Cover Crop – Common Species and Properties is a list of commonly used cover crop species in North Dakota, including information about the cover crops suitability for each purpose, plant growth characteristics and seeding recommendations. Evaluation of producer's intentions, site-specific conditions, and resource concerns are essential for selecting the species best suited to achieve the intended purpose(s). Table 1 is not an all inclusive list, since any crop could be considered as a cover crop. When planning/designing a cropping or forage system with a cover crop that is not listed, it is recommended that an NRCS Agronomist is consulted for species suitability.

In most cases, cover crop mixtures provide more or greater functions than single-species plantings. For example, oats and peas planted together tend to yield more and provide additional soil quality benefits then when planted alone. Where soil compaction is a concern, research has indicated a yield increase in crops following a cover crop of forage radish and rye, over following either planted alone.

Hairy vetch and sweet clover are not highly productive during the year of establishment, most of their production and/or function usually occurs during the second growing season. Consider planting these species with companion crops to maximize productivity (forage, soil organic matter, soil nitrogen, residue for erosion control) during the first year and where they will be able to grow the following crop year. Hairy vetch is not considered winter-hardy in USDA Plant Hardiness Zone 3. When used north of Interstate 94; hairy vetch should not be used alone and should not exceed 20% of a cover crop mixture.

During its first year, yellow sweet clover root growth practically doubles between October 1st and freeze-up. Consider the effect of "hard-seed" and potential problems with volunteer plants in subsequent cash crops when selecting cover crop species. Live, dormant seed that fails to germinate is called hard seed. Hard seed that germinates in subsequent crop years may present a future weed problem. For example, sweet clover typically has hard seed that may lie dormant in the soil for up to 20 years.

Two prolific seed producers, yellow sweet clover and black medic are listed as invasive in the ND Department of Agriculture Web-based Invasive Species Manual. These species should be avoided near rangeland, since they can spread into pastures and displace native vegetation and advance encroachment of introduced species such as smooth bromegrass and Kentucky bluegrass.

Where seed production by the cover crop is unwanted, planting the cover crop outside of its' normal seeding dates can be done. For example, winter grains planted in the spring or warm season species planted late enough to be terminated by frost prior to seed maturity. However, a long vegetative period for some species may increase the potential for several leaf diseases. If not killed, winter grains seeded in spring may bear seed the following year.

Seeding Guidelines

No-till or direct-seeding of cover crops is recommended, wherever possible. A firm, weed-free seedbed is desirable to ensure accurate seed placement and good seed-soil contact at the proper depth to facilitate germination and stand success. Cover crops have been grown successfully when seeded at the same time as the primary crop, inter-seeded or broadcast at some point after primary crop emergence and after harvest of the primary crop.

When applying cover crop by aerial or ground spreaders on bare soil, some method of light incorporation (harrowing, drilling of the primary crop, etc.) should be considered to cover the seed in order to initiate germination.

Large seed-size cover crops shall be planted with a drill, not broadcast. Cover crop mixes consisting of entirely fine seeds may be drilled or broadcast, see Table 1, Column 10 - Seed Size.

Seeding rates for individual crops when planted with a drill are provided in Table 1, Column 12 – Seeding Rate. It is recommended to increase seeding rates by 25-50% for broadcast seedings. There is a significant variety of potential cover crop mixtures and rates, depending on the intended purpose or result by planting the cover crop. Consult with an NRCS agronomist for recommendations on rates and mixture composition.

Seeding depth for mixtures should be based on an average of recommended depths for the selected species, Table 1 – Column 13, Seeding Depth.

Seeding dates should be based on the following guidelines:

- April 1 through June 15 – predominantly cool-season species
- June 15 through August 15 – predominantly warm-season species
- August 15 through September 20 – predominantly cool-season species

Note: Seeding dates may be adjusted up to 10 days by the District Conservationist, based on local weather and site conditions.

Most brassicas (mustard, winter rape or canola, radish, turnip) are very winter hardy and will not terminate growth until air temperatures are at 25 degrees Fahrenheit or less.

Planning Considerations

- Utilize cover crops to enhance crop diversity by adding crop types which are missing in the cash crop rotation (cool-season grass, cool-season broadleaf, warm-season grass, warm-season broadleaf).
- Check field conditions for multiple years of crop residue on the soil surface (an indicator of imbalance in the Carbon-Nitrogen Ratio). Plant residue with a lower C:N ratio will break down faster than plant residue with a high C:N ratio.
- Check for tillage-induced, restrictive (compaction) layers in the soil (use a tile spade to find crop roots growing horizontally above the compacted layer).
- Consider applying starter fertilizer (20-50 pounds of 18-46-0) especially in areas of nutrient-deficient or low organic matter soils and where residue accumulation is excessive, soil tests are recommended.
- Determine the leaching potential of design soil (refer to soil survey data or Nitrogen Loss Potential report from eFOTG) utilize soil test nitrogen reports to determine the amount and depth of nitrogen in the soil profile.
- Consider using seed sources already on hand to reduce expense.
- Consider harvesting cover crops with proper grazing, leaving at least 50% of the available biomass on the field.
- Utilize cover crops in a manner that provides sufficient ground cover to prevent erosion.
- Consider potential use of cover crops by wildlife for food or shelter.

GUIDANCE FOR PLANNED PURPOSES

Reduce Erosion from Wind and Water

Where the primary purpose of the cover crop is erosion control on cropland, tillage for seedbed preparation should be avoided or limited to maintain sufficient amounts prior crop residue necessary to control erosion to tolerable levels (T) or less. Most cover crop species, when allowed to grow near maturity provide sufficient residue to protect the soil surface. Refer to Table 1 – Column 1, Erosion Reduction for species selection.

Crops such as sugarbeets, edible beans, soybeans, and potatoes are very sensitive to wind damage from emergence to about the 4-5 leaf stage. The damage caused by sandblasting of tender seedlings by wind-borne soil particles, and physical damage from strong winds twisting and damaging the leaves and stems reduces both crop quality and yield. Use the current wind erosion prediction method to design and install a cover crop mix to reduce wind erosion to less than 0.5 ton per acre during the critical erosion period to protect seedlings.

When cover crops will be installed on sites where Critical Area Planting (342) is planned, plant the cover crop as soon as practical and according to the applicable seasonal requirement listed below. Seed perpendicular to the slope where water erosion is a potential hazard.

- Spring planting (prior to July) seed two bushels of small grains per acre.
- Summer planting (July and August) seed 30 pounds per acre of Sudan grass per acre.
- Fall planting (after August) seed two bushels of winter wheat or winter rye per acre.

Increase Soil Organic Matter Content

Select cover crop species which produce the greatest biomass (above and below ground), refer to Table 1, Column 2 – Increase Soil Organic Matter Content and Column 17 - Mycorrhizal Fungi Association. Improvements in soil quality are related to healthy and balanced soil biology. A diverse plant community, both above and below ground is essential in building and maintaining good soil quality.

Terminate the cover crop as late as possible prior to seeding the subsequent crop to maximize the harvest of sunlight and the production of biomass.

Capture and Recycle or Redistribute Nutrients in the Soil Profile

Select species based on their ability to utilize or uptake large amounts of nutrients from deeper in the soil profile. Consider the carbon to nitrogen (C:N) ratio and its effect on nutrient cycling and residue decomposition. Brassicas (mustard, canola, radish, turnip) typically root deeper; therefore, are able to capture and utilize nitrogen from deeper in the soil profile. Brassicas also have lower C:N ratios (less than 30:1) in their plant residue. Lower C:N ratios will typically increase the decomposition rate of plant residue and nutrient release for immediate crop use. Refer to Table 1, Column 3 – Capture/Recycle Soil Nutrients, Column 8 – Rooting Depth/Water Use and Column 15 – Carbon:Nitrogen Ratio.

Mycorrhizal fungi associated with the roots of many cover crops help to increase the capture and cycling of nutrients by effectively extending the reach of the crop's root system. See Table 1, Column 17 - Mycorrhizal Fungi Association, for information on the extent of mycorrhizal activity for each cover crop species.

Promote Biological Nitrogen Fixation

The amount of nitrogen (N) produced by a legume cover crop and the amount of N available to the following crop can be estimated with the procedures detailed on pages 22-23 of "Managing Cover Crops for Profitability", Third Edition, Sustainable Agriculture Network. http://www.sare.org/publications/covercrops/covercrops.pdf
The specific rhizobium bacteria for the selected legume will be applied at planting, if the bacteria are not already present in the soil.

It is not necessary to incorporate legume cover crop residue with tillage to utilize its nitrogen content. Leaving legume residue on the soil surface will result in some nitrogen being lost to volatilization. Nitrogen contained in crop residues left untilled is mineralized (made available to plants) at a slower rate, is less prone to leaching, and tends to be available to subsequent crops throughout the growing season. Tilling and disturbing the soil will initiate

a faster nitrogen release, but has substantial negative effects to soil carbon, soil organic matter, aggregate stability and overall soil quality .

Yellow sweet clover terminated at 6-10" height stage of its second year will provide 80% of its potential nitrogen benefit, while allowing an extended period for soil moisture recharge. Annual legumes do not fix a significant amount of nitrogen beyond the flowering stage. Refer to Table 1 – Column 4, Promote Biological Nitrogen Fixation, for cover crop species that fix nitrogen.

Increase Biodiversity
Cover crops are an excellent tool to add to the diversity of crop types within an existing crop rotation. For example, by planting warm-season cover crops after harvest of a cool-season crop and growing it out until termination by frost, allows for water use, nutrient cycling and additional biomass both above and below the soil surface.

The extra biomass provides nutrition to the insects, animals and micro-biology in the soil who decompose the crop residue throughout the growing season, adding diversity to the soil biology.

Cover crop mixes maximize chances for a good stand by avoiding reliance on just one variety and can enable you to accomplish many things at once. Also, mixes attract more beneficial insects because they bloom longer. The composition of these mixes may vary due to seed availability. Refer to Table 1, Column 11 – Crop Types and Column 16 – Attract Beneficial Insects when considering species for improving crop rotation diversity.

Pest Suppression
Mowing or clipping a cover crop prior to seed maturity helps control weeds by preventing potential seed production in the cover crop. Haying and removal of cover crop hay (millet, sudangrass, small grains) removes weed seeds from the field prior to maturity reducing potential infestations (refer to Table 1 – Column 5, Pest Suppression).

Winter cereals (wheat, rye and triticale) have vigorous growth which allows the plant to effectively compete with weed seedling, thereby suppressing or controlling weeds. Refer to NDSU Extension Bulletin A-199 for information on the use of rye in a crop rotation. http://www.ag.ndsu.edu/pubs/plantsci/smgrains/a199w.htm

Cover crops can be an important and effective component of an Integrated Pest Management program. Using diverse crop types with varying growth and plant characteristics will help to alter or break disease and insect life cycles. This occurs by changing the micro-climate in the crop canopy (shading, cooling, using soil moisture, etc.). Some plant pathogenic nematodes are suppressed by cover crops of oats, Brassicas (like oilseed radish and forage turnip), rye, sudangrass, and sorghum-sudangrass hybrids. Cover crops can be used to attract and trap insects away from cash crops.

Provide Supplemental Forage
Where cover crops are planted for supplemental grazing, Prescribed Grazing (528), shall be planned to ensure proper management of cover crop growth and used (take half, leave half) as a forage component of a planned grazing system. Where cover crops are intended for use as supplemental hay, Forage Harvest Management (511) shall be planned to provide quality forage and maintain soil quality benefits. Refer to Table 1, Column 7 - Provide Supplemental Grazing or Column 6 - Provide Supplemental Hay to determine suitable cover crop species.

Soil Moisture Management
Cover crops can improve the water cycle on cropland where plant moisture use (transpiration) is insufficient and help reduce soil salinity at or near the surface. Seeding cover crops early in the season and allowing them to grow until terminated by frost will maximize water use and the harvest of sunlight (refer to Table 1 – Column 8, Rooting Depth/Water Use).

When the primary purpose of cover crop is to utilize soil moisture, the cover crop should be allowed to grow until a killing frost unless early termination is needed to allow seeding of the next crop or to prevent seed production. Grass cover crops preceding a winter grain crop should be terminated by herbicides early enough (at least two weeks prior to planting of the winter wheat) to minimize competition for moisture and nutrients and eliminate the "green bridge" for leaf diseases.

Where limited soil moisture is a concern, the cover crop may be terminated early, while still achieving the other desired benefits. Manage soil moisture use by selecting efficient, water-using cover crop species and terminating the cover crop before excessive transpiration occurs.

When using a cover crop to manage for snow catch consider tall, strong-stemmed species like corn, sunflower, flax, etc, that remain upright over winter. These plants or their remaining stubble can effectively trap and distribute snow across a field, particularly on slopes and hilltops.

Other impacts of cover crops on soil moisture management include, canopy cover effects on soil temperature and evaporation, stubble height effects on snow catch, improvements in organic matter, water holding capacity, infiltration, and reduced compaction layers.

Reduce Particulate Emissions into the Atmosphere
Where the primary purpose of the cover crop is wind erosion control on cropland, tillage for seedbed preparation should be avoided or limited to maintain sufficient amounts of prior crop residue necessary to control erosion to tolerable levels (T) or less. Most cover crop species, when timely planted to allow sufficient growth prior to critical erosion periods, provide effective cover to protect the soil surface. Use the current wind erosion calculation method for determining the required amount of crop residue needed to control wind erosion and reduce PM10 emissions. Refer to Table 1 – Column 1, Erosion Reduction for species selection.

Minimize and Reduce Soil Compaction
Where soil compaction is the primary concern, consider using cover crops with strong tap roots or those that produce significant amounts of biomass (above and below the soil surface) to reduce existing soil compaction and make the soil more resistant to compaction.

By planting cover crops with deep taproots such as brassicas (forage radish, turnips), sweet clover and sunflower, or sudangrass, subsoil compaction can be reduced, improving infiltration and soil porosity. Grass crops like wheat, barley, rye or triticale with fibrous root systems, add significant biomass on the soil surface within the root zone, reducing the potential for surface crusting and improving soil structure, aeration, and infiltration.

Planting a mixture of strong, tap-rooted and shallower, fibrous-rooted species tends to provide the greatest potential benefit when treating areas with soil compaction concerns, by improving soil organic matter and structure, while breaking through the deeper compaction layers. Refer to Table 1 – Column 9, Minimize / Reduce Soil Compaction for species selection.

Operation and Maintenance
Prevent damage to the cover crop from fire, herbicide drifts, excessive grazing, cutting it too short, and early termination.

Control growth of under-seeded cover crops as needed to manage moisture competition and shading stress on the primary crop.

Control weeds and other pests in cover crops by mowing, haying, grazing, or using other appropriate integrated pest management techniques.

CHECK OUT AND DOCUMENTATION

- Document this practice with ND-CPA-303E Cropland Management Documentation Worksheet or ND-CPA-305 Cover Crop Workbook.
    - Record the decision-maker's purpose(s) for applying the cover crop(s).
    - Record site conditions at planting time (soil condition, residue cover, weeds, etc.)
    - Document planned cover crop mix, seeding date(s), rates, and method.
- Document the practice area on the plan map (aerial photo, ARCGIS map), indicating the area planted and legal description.

- Attach soil erosion prediction data, use current approved wind and water erosion prediction technology, as appropriate. When a cover crop is planned to protect crops against soil abrasion or blow-out, identify the crop to be protected and its tolerance to wind erosion.
- Use RUSLE2 to determine the Soil Conditioning Index, where applicable.
- Where supplemental grazing of cover crops is planned, include documentation of use for the Prescribed Grazing plan.
- Assistance notes will document producer's site-specific conditions, discussions with decision-maker, and any factors relevant to the plan.
- Certify this practice by documenting with visual assessment, photo documentation and/or appropriate assistance notes indicating practice installation completed according to NRCS standards and design, date, and sign.

REFERENCES

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